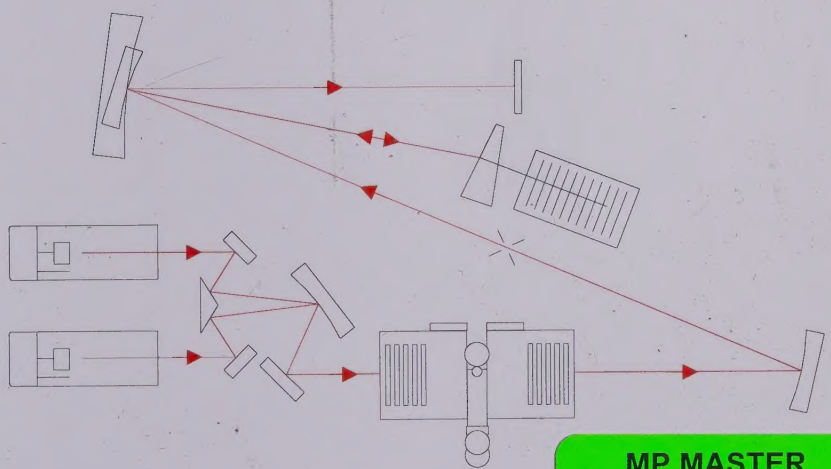
Atomic Spectrometry

SIMAA 6000

Simultaneous Multi-element Atomic Absorption Spectrometer

Maintenance Guide



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PERKIN ELMER

Atomic Spectrometry

SIMAA 6000

Simultaneous Multi-element
Atomic Absorption Spectrometer

Maintenance Guide

PERKIN ELMER

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Other guides supplied with SIMAA 6000

In addition to this guide, there are a number of other guides supplied with your SIMAA 6000 analysis system.

Installation

Describes how to install the SIMAA 6000 analysis system and the special requirements of the laboratory where you install it.

System Description

Describes how the SIMAA 6000 analysis system works and gives technical data about the system. It also includes translations of the warnings used in the SIMAA 6000 user's guides.

Setting Up and Performing Analyses

It describes in detail how to set up the system to perform multi-element analyses with the graphite furnace. It also gives a summary of the steps you need to perform the analysis — detailed procedures are in the online help, see below.

Online help

This is integrated into the AA WinLab software that controls the system. It is a context-sensitive help system that describes the commands and controls and contains detailed procedures for performing analyses. Since you use the AA WinLab software to start and control the analyses, and since the online help is context-sensitive, the information you need is always available at your fingertips while you are using the system.

THGA Recommended Conditions and Techniques

This gives advice on instrument settings and analytical procedures and techniques for use with the THGA graphite furnace.

Safety Information

1

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Introduction

The user's guides provided with your analytical instrument contain information and warnings that you must follow to ensure safe operation and to maintain the instrument in a safe condition. This advice is intended to supplement, not supersede, the normal safety code of behavior prevailing in the country of operation.

This chapter describes general safety practices for atomic spectroscopy and potential hazards with various atomic absorption techniques.
The information provided does not cover every safety procedure that should be practiced. Ultimately, maintenance of a safe laboratory environment is the responsibility of the user and the user's organization.

Correct use of analytical instruments

Before you install or use your instrument, and in order to get the best results, you should be familiar with all of the instruments in the system and know how to operate them. You should also be aware of the safety procedures in force in your laboratory, especially those concerning atomic spectroscopy instruments. Read the user's guides supplied with the instruments before you start.

If you use the instrument in a manner not specified in the handbooks, or if you use it for a purpose other than that intended, you may damage the instrument, or compromise your own, or someone else's, safety.

Analytical instruments should only be operated by persons who are suitably qualified and have received adequate training.

W1.2

Warning: Unauthorized Adjustments and Servicing

Only a Perkin-Elmer service engineer or similarly trained and authorized person should be permitted to service the instrument.

- *Do not attempt to make adjustments, replacements, repairs, or modifications to this instrument except as described in the documentation supplied with the instrument.*

Magnetic field

Zeeman graphite furnace systems

The electromagnet generates a strong magnetic field inside the furnace during measurement cycles.
There is a weak, accessible, stray magnetic field around the graphite furnace. This stray magnetic field can affect heart pacemakers and metallic implants up to 0.6 meter from the furnace in all directions. This stray field can also affect other instruments, watches, and magnetic storage devices.

- Do not operate the furnace when persons wearing electronic heart pacemakers, or having other metallic implants, are present.
- Anyone wearing a heart pacemaker or having metallic implants should remain at least 0.6 meter away from the furnace – in any direction – while the furnace is operating.

High temperatures

Graphite furnace

The THGA graphite furnace can generate temperatures of up to 2600 °C.

- Do not touch any part of the graphite furnace until it has cooled to room temperature.
- Do not attempt to inject a sample into the graphite tube when the furnace is hot. You may be subjected to fumes from the sudden vaporization of the sample, and may damage the pipet.

Quartz tube atomizer cell

The quartz tube atomizer cell (QTA-cell) used for the hydride-generation technique can reach temperatures of up to 1000 °C.

- Do not touch any part of the heating mantle (electrically heated systems), or the cell holder (flame-heated systems), or the QTA-cell until they have cooled to room temperature.

UV radiation

You should be aware of the health hazard presented by UV radiation.

- When the instrument is on, do not remove any covers unless specifically instructed to do so in the user's guide since otherwise you may be exposed to potentially hazardous UV radiation.
- Always wear UV-absorbing eye protection when viewing any of these sources:
  - The graphite furnace when it is heated to incandescence.
  - Hollow cathode or electrodeless discharge lamps.

Operating conditions

W1.3

Warning: Explosive Atmosphere

This instrument is not designed for operation in an explosive atmosphere.

The instrument will operate correctly under the following conditions:

- Indoors
- Ambient temperature +15 °C to +35 °C (+59 °F to +95 °F).
- Ambient relative humidity 20% to 80%, without condensation.
- Altitude in the range 0 m to 2000 m

You can store the instrument safely under the following conditions:

- Indoors
- Ambient temperature –20 °C to +60 °C (–4 °F to +140 °F)
- Ambient relative humidity 20% to 80%, without condensation.
- Altitude in the range 0 m to 2000 m.

  When you remove the instrument from storage, before you put it into operation allow it to stand for at least a day under the approved operating conditions.

Safety conventions in the User's Guides

Possible hazards that could harm the user or result in damage to the instrument are clearly stated at appropriate places throughout the user's guides.

Any of the following safety conventions can be used throughout these user's guides:

*This symbol alerts you to situations that could result in **personal injury** to yourself or other persons.*
Details about these circumstances are in a box like this one.

*This symbol alerts you to the risk of **electric shock** that could result in **personal injury** to yourself or other persons.*
Details about these circumstances are in a box like this one.

*This symbol alerts you to the risk of **hot surfaces** that could cause **personal injury** to yourself or other persons.*
Details about these circumstances are in a box like this one.

*This symbol alerts you to the risk of **ultraviolet radiation** that could cause **eye damage** to yourself or other persons.*
Details about these circumstances are in a box like this one.

Caution:
*The term CAUTION alerts you to situations that could result in **serious damage to the instrument** or other equipment.*
Details about these circumstances are described in a message similar to this one.

General safety practices

Laboratory hygiene

- Keep the work area scrupulously clean to avoid contaminating your samples and to maintain a safe working environment. Clean up spilled chemicals immediately and dispose of them properly.
- Do not allow smoking in the work area. Smoking is a source of significant contamination and also a potential route for ingesting harmful chemicals.
- Do not store, handle, or consume food in the work area.

Laboratory ventilation

Toxic combustion products, metal vapor, ozone, etc., can be generated by the system, depending on the type of analyses being performed.

- You must provide an efficient laboratory ventilation system to remove toxic products generated during instrument operation.

Electrical safety

Two versions of the SIMAA 6000 spectrometer are available, a 240 V, 60 Hz version, and a 3~230 V, 50 Hz version. Each versions is fitted with a special connector suitable for the intended power supply. The spectrometer must be installed by a Perkin-Elmer service engineer.

W2.1

Warning: Electrical Hazard

Any interruption of the protective conductor inside or outside the instrument or disconnection of the protective conductor (earth/ground) terminal is likely to make the instrument dangerous.
Intentional interruption is prohibited.

Lethal voltages are present in the instrument

- *Even with the power switch off, line power voltages can still be present within the instrument.*
- *When the instrument is connected to line power, terminals may be live, and opening covers or removing parts (except those to which access can be gained without use of a tool) is likely to expose live parts.*
- *Capacitors inside the instrument may still be charged even if the instrument has been disconnected from all voltage sources.*

When working with the instrument:

- Connect the instrument to a correctly installed line power outlet that has a protective conductor (earth/ground).
- Do not attempt to make internal adjustments or replacements except as directed in the handbooks provided with the instrument.
- Do not operate the instrument with any covers or parts removed.
- Disconnect the instrument from all voltage sources before opening it for any adjustment, replacement, maintenance, or repair.
  If, afterwards, the opened instrument must be operated for further adjustment, maintenance, or repair, this must only be done by a skilled person who is aware of the hazard involved.
- Use only fuses with the required current rating and of the specified type for replacement.
  Do not use makeshift fuses or short-circuit the fuse holders.
- Whenever it is likely that the instrument is no longer electrically safe for use, make the instrument inoperative and secure it against any unauthorized or unintentional operation.

  The instrument is likely to be electrically unsafe when it:
  - Shows visible damage.
  - Fails to perform the intended measurement.
  - Has been subjected to prolonged storage under unfavorable conditions.
  - Has been subjected to severe transport stresses.

Waste disposal

Contents of waste containers

The materials that you collect in waste containers may include small amounts of the substances that were analyzed and other chemicals used in the analyses. If these materials are toxic, corrosive, or contain organics you may have to treat the collected effluent as hazardous waste. Refer to your local safety regulations for proper disposal procedures.

Disposing of defective lamps

Hollow cathode lamps and electrodeless discharge lamps contain small quantities of the lamp element in a very pure form. If a lamp containing toxic elements becomes defective or otherwise unusable, you must treat it as hazardous waste and dispose of it accordingly. A licensed company in the chemical waste disposal business can provide lamp disposal in accordance with environmental regulatory requirements. Please note that Perkin-Elmer does not take back defective lamps for disposal.
In addition, hollow cathode lamps and deuterium lamps are maintained under reduced pressure. Handle and dispose of them correctly to minimize the implosion risk.

For information, the quantities of analyte material contained in the cathodes of hollow cathode lamps are listed in the table below:

Quantity of material in the cathode	*Single-element hollow cathode lamps*	*Multi-element hollow cathode lamps*
less than 5 g	As, Au, B, Ba, Be, Ca, Dy, Er, Eu, Ga, Gd, Ge, Hf, Ho, In, Ir, K, La, Li, Mg, Na, Nd, Pd, Pr, Pt. Re, Rh, Ru, Sc, Se, Sm, Sn, Ta, Tb, Tm, Yb, Y	Na-K, Pt-Ru
5–10 g	Ag, Al, Bi, Cd, Co, Cr, Mn, Mo, Ni, Sb, Si, Sr, Te, V, W, Zn, Zr	Ca-Mg, Ca-Zn, Ag-Au, Sn-Te, Ca-Mg-Zn, Ca-Mg-Al
10–15 g	Cu, Fe, Hg, Nb, P, Pb, Ti, Tl	all other multi-element HCLs

For EDLs, the quantity of analyte material used is much less than the quantities used in HCLs. Typically, only several milligrams of material are placed in the EDL bulb. No Perkin-Elmer EDLs (System 1 or 2) contain more than 0.05 g of analyte material.

Safe handling of chemicals

Some chemicals used with the instrument may be hazardous or may become hazardous after completion of an analysis.

The responsible body[1] must take the necessary precautions to ensure that the surrounding workplace is safe and that instrument operators are not exposed to hazardous levels of toxic substances (chemical or biological) as defined in the applicable national, state, and local health and safety regulations and laws. Venting for fumes and disposal of wastes must be in accordance with all national, state, and local health and safety regulations and laws.

- Use, store, and dispose of chemicals in accordance with the manufacturer's recommendations and the applicable national, state, and/or local regulations.
- Wear appropriate eye protection at all times while handling chemicals. Depending on the types of chemicals you are handling, wear safety glasses with side shields, or goggles, or a full-face shield.
- Wear suitable protective clothing, including gloves if necessary, resistant to the chemicals you are handling.
- When preparing chemical solutions, always work in a fume hood that is suitable for the chemicals you are using.
- Perform sample preparation away from the instrument to minimize corrosion and contamination.
- Clean up spills immediately using the appropriate equipment and supplies, such as spill cleanup kits.
- Do not put open containers of solvent near the instrument.
- Store solvents in an approved cabinet (with the appropriate ventilation) away from the instrument.

1. Definitions from IEC 1010-1:
   Responsible body: 'individual or group responsible for the use and maintenance of equipment, and for ensuring that operators are adequately trained.'
   Operator: 'person operating equipment for its intended purpose.'

Handling compressed gases

Note: *The permanent installation of gas supplies is the responsibility of the user and should conform to local safety and building regulations.*

Summary of gas hazards

Hazards associated with the different gases used in atomic absorption spectrometry are presented in the table below:

Gas	Suffocation	Explosion	Spontaneous Decomposition or Combustion
Air	–	–	–
Argon	x	–	–
Nitrogen	x	–	–
Acetylene (ethyne, C_2H_2)	x	x	x
Nitrous Oxide (dinitrogen monoxide, N_2O)	x	–	x

Contact the gas supplier for a safety data sheet containing detailed information on the potential hazards associated with the gas.

Identifying cylinders

- Legibly mark cylinders to clearly identify the contents and status (full, empty, etc.). Use the chemical name or commercially accepted name for the gas.

Handling cylinders

- Move cylinders with a suitable hand truck after making sure that the valve cap is securely in place and that the cylinder is properly fastened to the hand truck.
- Use only approved regulators, tubing, and hose connectors. When you connect fittings, keep in mind that left-hand thread fittings are used for fuel gas connections (e.g., acetylene), whereas right-hand thread fittings are used for oxidant and support gas connections (e.g., nitrous oxide, air).
- Arrange gas hoses where they will not be damaged or stepped on and where things will not be dropped on them.
- Do not 'crack the valve' or open the valve of an acetylene cylinder before attaching a regulator.

- Do not attempt to refill gas cylinders.
- Check the condition of pipes, hoses, and connectors regularly, and replace any damaged parts.
- Perform periodic gas leak tests at all joints and seals of the gas system by applying an approved gas leak detection solution.

Storing cylinders

- Store cylinders in accordance with the applicable national, state, and/or local regulations and standards.
- When gas cylinders are stored in confined areas, such as a storage room, make sure that ventilation is adequate to prevent toxic or explosive accumulations of gas.
  The storage room should be well ventilated and dry. This is particularly important in confined areas.
- Do not store cylinders near elevators, gangways, or in locations where heavy moving objects may strike or fall against them.
- Use and store cylinders away from exits and exit routes.
- Locate gas cylinders away from heat sources, including heat lamps. Compressed gas cylinders should not be subjected to temperatures above 52 °C (125 °F).
- Do not allow ignition sources in the storage area and keep cylinders away from readily ignitable substances such as gasoline or waste, or combustibles in bulk, including oil.
- Store all gas cylinders only in a vertical position, with the valve cap in place, and fastened securely to an immovable bulkhead or a permanent wall.
- If you are storing cylinders outdoors, store them above ground on a suitable floor where they are protected against temperature extremes (including the direct rays of the sun).

References for laboratory safety practice

- Bretherik, L., *Bretherik's Handbook of Reactive Chemical Hazards*, 4th ed., Butterworth & Co. Ltd., London, UK, 1990.
- Bretherik, L., *Hazards in the Chemical Laboratory*, 3rd ed., Royal Society of Chemistry, London, UK, 1981.
- *CRC Handbook of Laboratory Safety*, 3rd ed., Furr, K., ed., The Chemical Rubber Co. Press, Florida, USA, 1990.
- *Prudent Practices for Handling Hazardous Chemicals in Laboratories*, National Research Council, National Academic Press, Washington D.C., USA, 1981.
- Sax, N., ed., *Dangerous Properties of Industrial Materials*, 7th ed., Van Nostrand Reinhold, New York, 1989.
- Compressed Gas Association, Inc., Arlington, VA 22202, USA, various publications.
- Data Sheets provided by chemical manufacturers, e.g.:
  – USA, Material Safety Data Sheets (MSDS),
  – FRG, DIN-Sicherheitsblätter,
  – UK, Hazard Data Sheets.

Symbols used on the instrument

Any of the following symbols can be used on the instrument:

This symbol indicates that there is a potential hazard and that the user must look in the handbook for an explanation of the hazard and how to avoid it.

This symbol indicates the risk of electric shock.

This symbol indicates the risk of hot surfaces.

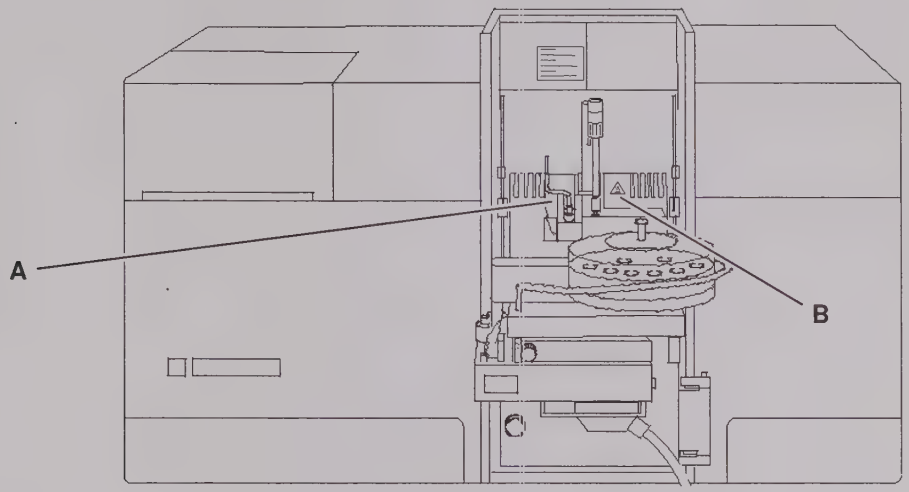
This symbol indicates the off position of the main power switch or circuit breaker. With the switch in this position, the instrument is disconnected entirely from the line power supply.

This symbol indicates the on position of the main power switch or circuit breaker. With the switch in this position, the instrument is connected to the line power supply but is not necessarily switched on and operational.

This symbol indicates the operational on/off switch.
This switch turns the instrument on and off, but it does not disconnect the instrument from the line power supply.

This symbol indicates alternating current.

Warning markings on the front of the instrument



A

0.6 m

Strong Magnetic Field
Anyone wearing a heart pacemaker or having metallic implants should remain at least 0.6 meter away from the furnace – in any direction – while the furnace is operating.

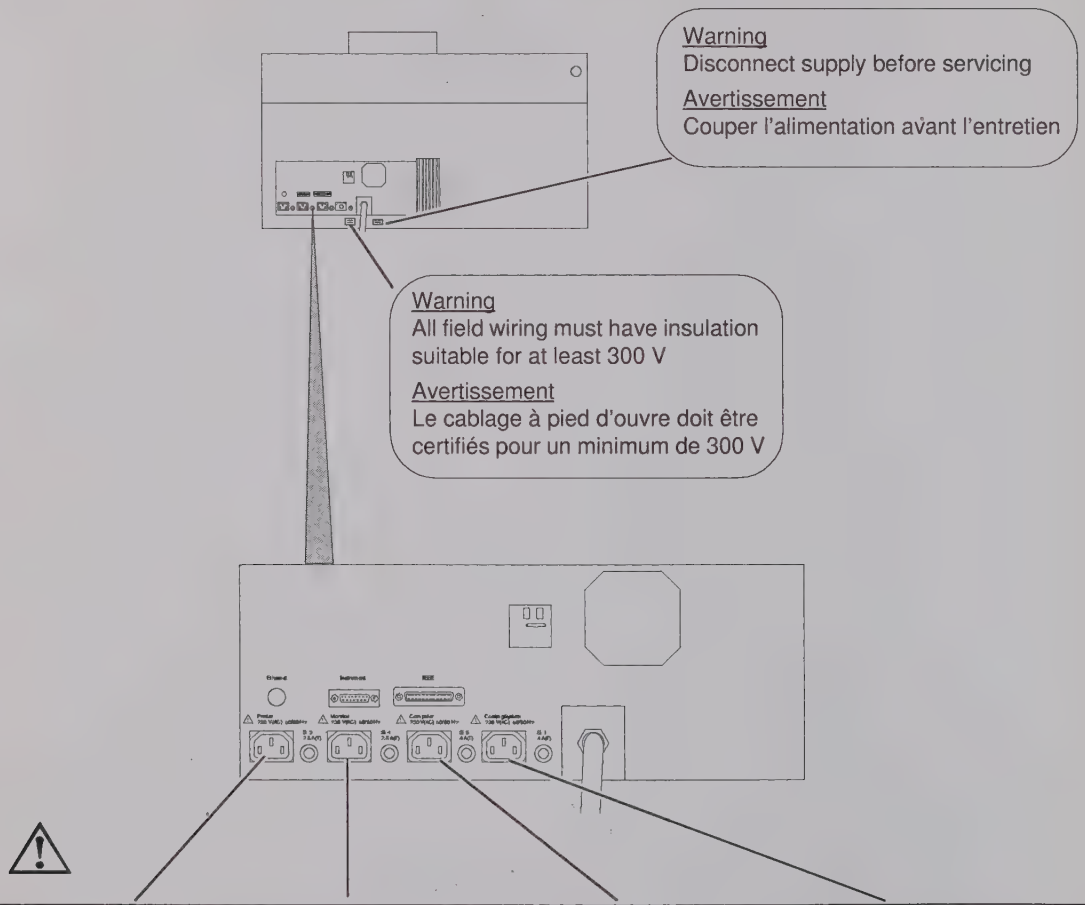
Champ magnétique intense
Tout personne ayant un stimulateur cardiaque ou des implants métalliques doit rester éloignée d'au moins 0,6 m du four pendant le fonctionnement de celui-ci.

Starkes Magnetfeld
Herzschrittmacherträger und Personen mit Metall-Implanten müssen zum Magneten einen Sicherheitsabstand von mindestens 0,6 m in jeder Richtung um den Magneten einhalten.

B

Risk of hot surfaces
Risque de surfaces chaudes
Gefahr durch heiße Oberflächen

Warning markings on the rear of the instrument


Warning
Disconnect supply before servicing
Avertissement
Couper l'alimentation avant l'entretien
Warning
All field wiring must have insulation suitable for at least 300 V
Avertissement
Le cablage à pied d'ouvre doit être certifiés pour un minimum de 300 V

Printer Imprimante 230 V(AC) 50/60 Hz	Monitor Ecran 230 V(AC) 50/60 Hz	Computer Ordinateur 230 V(AC) 50/60 Hz	Cooling System Système de Refroidissement 230 V(AC) 50/60 Hz
The power outlets shown above provide 230 V (AC) at 50 or 60 Hz in both 240 V and 3~230 V instruments. Only connect ancillary equipment to these sockets if the equipment requires 230 V at 50/60 Hz.			*Only connect the Cooling System to this socket. This is an automatically switched socket controlled by the spectrometer.*

Spectrometer Maintenance 2

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Introduction

W1.2

Warning: Unauthorized Adjustments and Servicing

Only a Perkin-Elmer service engineer or similarly trained and authorized person should be permitted to service the instrument.

- *Do not attempt to make adjustments, replacements, repairs, or modifications to this instrument except as described in the documentation supplied with the instrument.*

If the spectrometer system will not function correctly...

- Switch off the spectrometer system and make sure it cannot be operated.
- Contact your local Perkin-Elmer office.

You should only perform the maintenance procedures described in this handbook. For any other maintenance or service contact your local Perkin-Elmer office to arrange for a service engineer to visit.
In particular you should only allow a Perkin-Elmer service engineer or similarly trained and authorized person to perform any work on:

- Electrical components inside the instrument;
- The gas connections and gas system pneumatics;
- The monochromator and all other optical system components.

Before the service engineer arrives:

1. Make sure that the instrument and work area are clean.
2. Empty the furnace autosampler waste bottle.

Troubleshooting

See the *Troubleshooting* guide supplied with the system. This includes information about problems that can arise with both the software and the spectrometer system.

Routine maintenance checklist

Spectrometer, maintenance checklist	
External surfaces	Wipe over the surfaces with a lint-free cloth moistened with a dilute solution of laboratory detergent. The surfaces are resistant to dilute acids and alkalis, and to a lesser extent to strong acids and alkalis and organic solvents.
Atomizer compartment windows, lamp end windows	These windows do not normally require cleaning but if they become marked, e.g., with fingerprints, you can clean them (*procedure: page 2-5*).
Air filters	Fit new filters yearly or more often in a dusty environment (*procedure: page 2-7*).

General preventative maintenance procedures	
Instrument and work area	For safety reasons, and to avoid contaminating new samples, you should make sure that the instrument and the work area are always absolutely clean. This is especially important when you are working with toxic substances and when you are measuring trace amounts of any elements. Wipe up spills immediately before they can cause further contamination or damage. Before you leave the instrument standing idle for any period of time, make sure that all the components are clean.
Fume ventilation	Make sure that the laboratory fume ventilation system functions correctly. Always switch it on when you are using the instrument.
Environmental conditions	Make sure that the environmental conditions are as described in *Laboratory Requirements* in the *Installation* guide.

Cleaning the windows of the optical system

Caution: Risk of damage to optical components

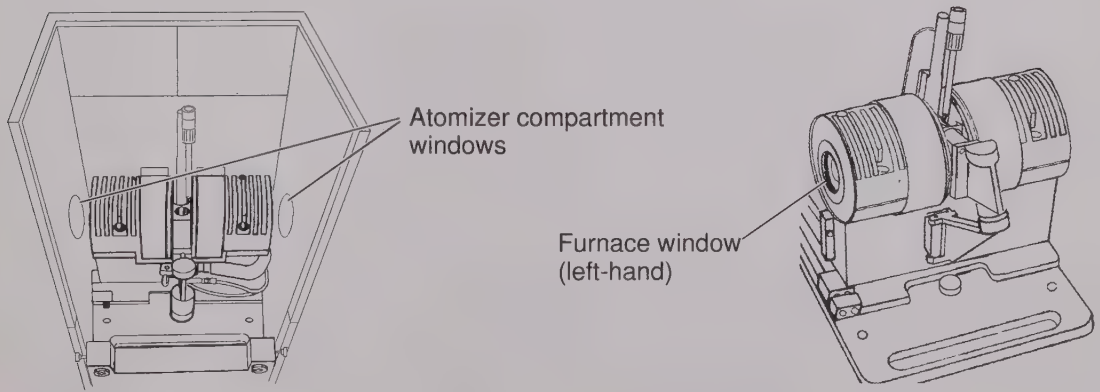
Never touch or clean the surfaces of the grating or mirrors.
If mirror surfaces are scratched they must be resurfaced.
Do not allow cleaning fluids to come into contact with any of the reflecting surfaces.

Most of the optical components are under the main cover of the spectrometer and are protected by the black optics covers. Usually these components require no maintenance, provided the laboratory fume ventilation system is working correctly and the environmental conditions are as described in the *Laboratory Requirements* in the *Installation Guide*.
If mirror surfaces need cleaning, this must be done by a Perkin-Elmer service engineer who knows the special techniques required.

The only optical parts that are exposed and that you may clean are:

- The atomizer compartment windows.
- The front windows of the lamps.
- The furnace windows. Cleaning the furnace windows is described in the *Furnace* maintenance chapter.

These windows are important parts of the whole optical system. Handle them carefully, as you would any sensitive optical component. Do not directly touch the windows.



To clean the windows:

This must be done only by a skilled person who knows the special techniques required.

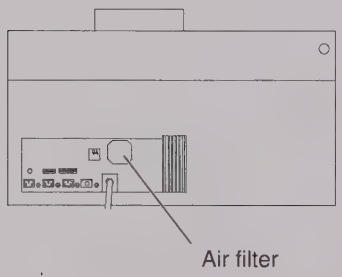
Note: *The more you rub the surface of the windows, the more chance there is of scratching them. You must change scratched windows.*

1. Blow dust off optical surfaces with clean dry air before you attempt to clean them. Do not rub the surfaces.
2. Clean the window surfaces with a soft lint-free cloth moistened with spectroscopic grade alcohol. The window must dry quickly to avoid leaving drying marks.
   Keep the cleaning solutions and water away from other parts of the instrument.

Changing the air filters

To make sure that the electrical components in the spectrometer are properly cooled, the air filter must allow sufficient air into the instrument. Check the filter regularly and change it when it becomes dirty.
You should not need to change the filter more than once every year if the environmental conditions are as described under *Laboratory Requirements* in the *Installation* guide.
Replacement filters are available; see the chapter: *Parts and Supplies* for the part number.

1. Carefully pull off the snap-on plastic grid that holds the air filter in place.
2. Replace the filter and push the grid back into place.



Maintaining the electrical components

W2.3

Warning: Electrical Hazard

- *To prevent potential injury to yourself and damage to the instrument, switch OFF all instruments in the system and disconnect them from the line power supply before you perform the procedures described below.*

Parts that may be serviced by the user

The only parts that you should attempt to maintain are those described below. The electronic components in the instrument do not contain any parts which you can maintain yourself. If there is a problem, contact your local Perkin-Elmer office.
If any fuses blow frequently or if the automatic circuit breaker switch is activated frequently, contact your local Perkin-Elmer office for advice.

Resetting the automatic circuit breaker

The spectrometer has an automatic circuit breaker which prevents the system from drawing too much current.
When the circuit breaker is activated, the switch flips to the off position (marked O). This can happen while an analysis is running.

1. To reset the switch, wait a few seconds then put the switch to the on position (marked I).
   If this switch is activated frequently, contact your local Perkin-Elmer office for advice.

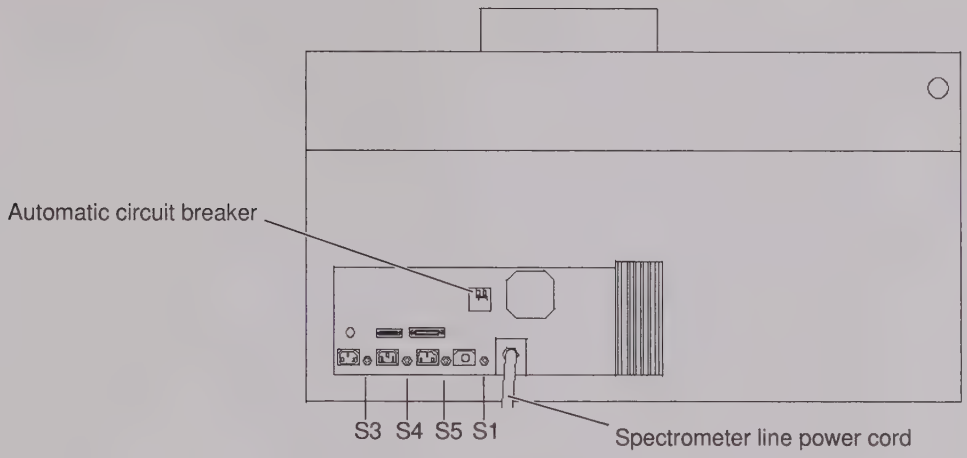
Changing the fuses

W2.9

Warning: Electrical Hazard

- *Use only fuses with the correct current rating and of the specified type for replacement.*
- *Do not use makeshift fuses and do not short-circuit the fuse holders.*

1. Switch off the spectrometer and all other instruments in the system as described in the relevant handbooks.
2. Switch the circuit breaker on the rear panel of the spectrometer to the off position (marked O).



3. Disconnect the spectrometer's line power cord from the line power supply.
4. Disconnect all the line power cords from the sockets at the rear of the spectrometer.
5. To change the fuses numbered S1, S3, S4, S5:
    1. Insert the tip of a suitable screwdriver in the slit of the fuse holder and unscrew the fuse holder.
    2. Remove the blown fuse, then insert a new one of the correct type and rating. The correct rating is shown on the label of the fuse on the rear panel of the spectrometer.
    3. Screw the fuse holder into the correct socket.
6. Reconnect the line power cords correctly — see the *Installation* guide.

Furnace Maintenance 3

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Introduction

W1.2

Warning: Unauthorized Adjustments and Servicing

Only a Perkin-Elmer service engineer or similarly trained and authorized person should be permitted to service the instrument.

- *Do not attempt to make adjustments, replacements, repairs, or modifications to this instrument except as described in the documentation supplied with the instrument.*

If the furnace will not function correctly...

- Switch off the spectrometer system and make sure it cannot be operated.
- Contact your local Perkin-Elmer office.

You should only perform the maintenance procedures described in this handbook. For any other maintenance or service contact your local Perkin-Elmer office to arrange for a service engineer to visit.
In particular you should only allow a Perkin-Elmer service engineer or similarly trained and authorized person to perform any work on:

- Electrical components inside the instrument;
- The gas connections and gas system pneumatics;

Before the service engineer arrives:

1. Make sure that the instrument and work area are clean.
2. Empty the furnace autosampler waste bottle.

Troubleshooting

See the *Troubleshooting* guide supplied with the system. This includes information about problems that can arise with both the software and the spectrometer system.

Routine maintenance checklist

Furnace, maintenance checklist	
If you analyze samples that have 'dirty' matrices, such as blood, sugar or oil, you will probably have to clean the components more often than if you were analyzing 'clean' samples, such as drinking water.	
Graphite tube	If the tube is contaminated, for example: deposits around the injection hole or on the L'vov platform, you may be able to clean the tube (*procedure: page 3-9*). If the contact surfaces are pitted or cracked, install a new tube.
Graphite contacts	Check the condition of graphite contacts. If they are pitted or cracked, install new ones (*procedure: page 3-14*). Every time that the furnace is opened, remove any particles from inside the contacts using a stream of clean compressed air or a cleaning swab. **Wear safety glasses when doing this.**
Furnace windows	Clean the windows regularly (*procedure: page 3-24*). How frequently depends on the type of samples being analyzed.

Opening the furnace and removing the graphite tube

To open the furnace

W4.3

Warning: High Temperatures – Risk of Burns

The graphite furnace can generate very high temperatures.

- *Do not touch any parts of the furnace, especially the graphite components, until they have cooled to room temperature.*

1. Make sure that the furnace is cool.
2. Release the pressure holding the furnace closed:

   If the spectrometer is switched on, in the **Furnace Control** window, click on **Open/Close**.

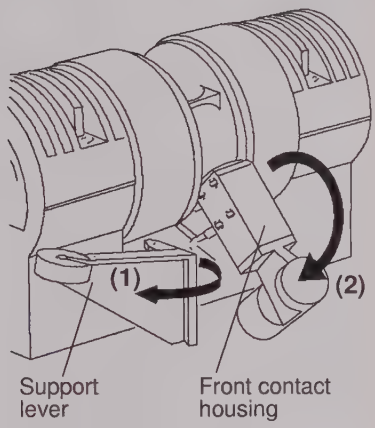
   –or–

   If the spectrometer is switched off:

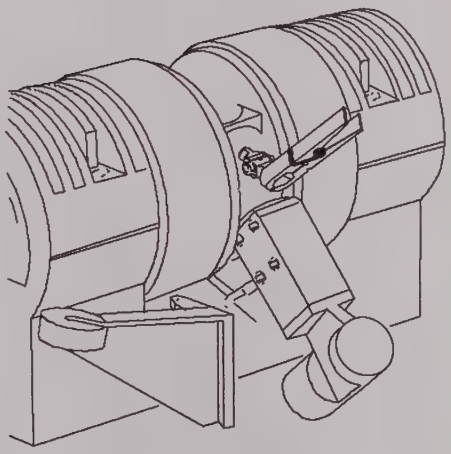
   1. Turn off the normal (argon) and special gas supplies.
   2. Disconnect the normal gas tube from the inlet manifold on the spectrometer. To do this, carefully push the locking ring of the connector into the connector and pull the tube out of the connector.

3. Swing the support lever to the side **(1)**.

   Tilt the front contact housing downward **(2)**.

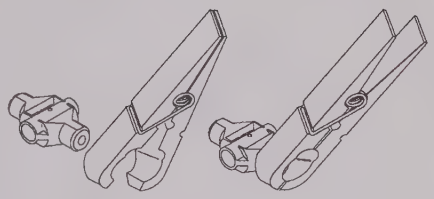


The graphite tube is now visible in the rear contact.
Use the grips provided to remove the graphite tube.
Do not touch the tube with bare fingers.

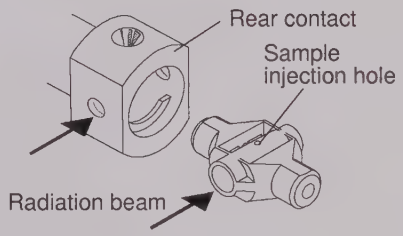


Inserting the graphite tube and closing the furnace

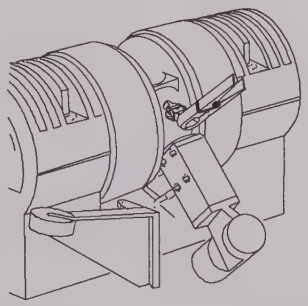
Note: *Do not touch the graphite tube or contacts with your fingers. Use the grips provided to hold the graphite tube. Perspiration can affect the tube lifetime and the analytical results by contaminating and damaging the surface of the graphite.*



1. When you insert the graphite tube, make sure that:
   - The sample injection hole is uppermost.
   - The side of the tube where the platform is attached to the tube faces the rear of the furnace. The platform is then higher towards the rear.

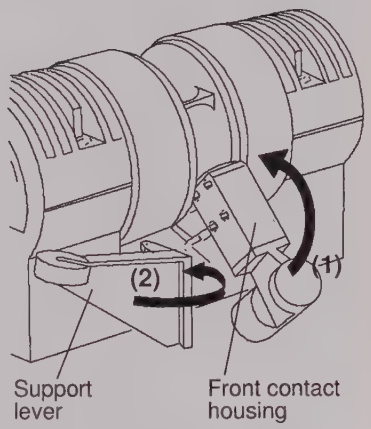


2. Use the grips provided to insert the graphite tube into the rear contact.



To close the furnace

1. Carefully tilt the front contact housing up into the closed position **(1)**.
2. Swing the support lever underneath the front contact housing **(2)**.
3. Return the furnace back to the operating position in the atomizer compartment *(procedure: page 3-12)*.
4. If you disconnected the gas supplies, reconnect them correctly.
5. Activate the pressure that holds the furnace closed:
   In the **Furnace Control** window, click on **Open/Close**.



6. If you have installed a new graphite tube, condition the graphite tube (*procedure: page 3-10*).
   If you are reusing a previously conditioned graphite tube, heat manually at 2500 °C for 5 seconds to remove contamination (*procedure: page 3-11*).

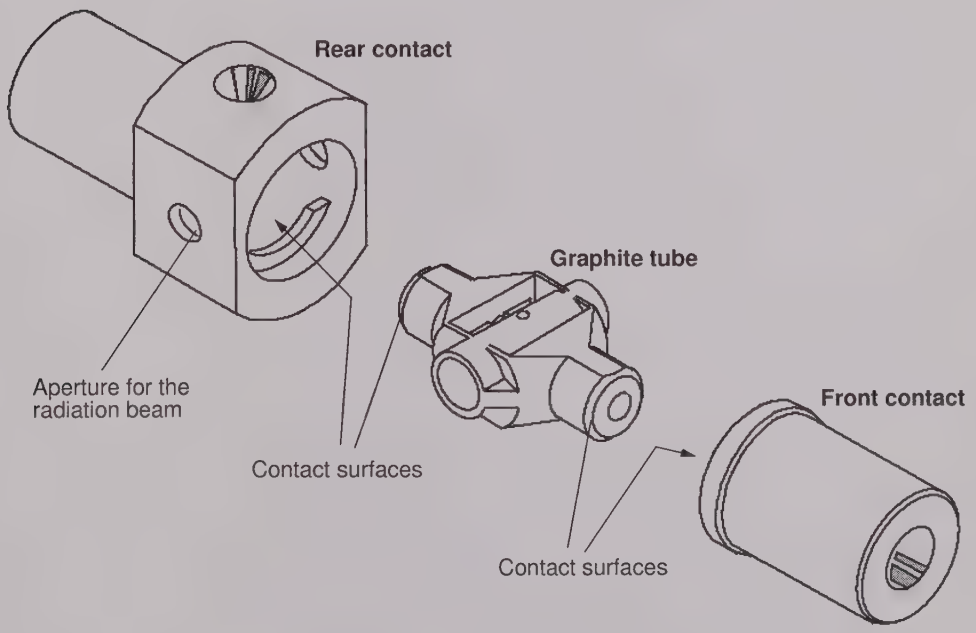
Note: *Every time you open the furnace, subsequently always heat it out manually at 2500 °C for approximately 5 seconds.*

7. Check alignment of the furnace autosampler.

Cleaning the graphite tube and graphite contacts

Good, reproducible analytical results depend on good electrical contact between the graphite contacts and the graphite tube. The contact surfaces of the graphite tube and the contacts must be smooth and clean to allow good electrical contact. After prolonged use the contacts may become contaminated with remains of samples and small particles of graphite. Even quite small particles can spoil the contact and cause poor analytical results.
Every time that you open the furnace, clean the contacts as described below.

Note: *Do not touch the graphite tube or contacts with your fingers. Perspiration can affect the tube lifetime and the analytical results by contaminating and damaging the surface of the graphite.*
If a graphite tube breaks inside the furnace you must remove all the remnants and thoroughly clean the contacts.



Heating the graphite tube to remove contamination

You can usually remove contamination from the graphite tube by heating the tube. Use the furnace program that is designed for conditioning the graphite tube. If there are stubborn deposits in the tube that you cannot remove, discard the tube and use a new one.

To condition the graphite tube

We recommend that you run the graphite tube conditioning program every time that you change the graphite tube. The conditioning procedure removes adsorbed gases and surface contamination from the graphite, and ensures reproducible performance.

After conditioning it is good practice to verify that the tube and/or platform are sufficiently clean for the element you wish to determine.
In order to do this, run your method for this element, but do not inject a sample. Perform a 'dry fire' instead. Evaluate the results obtained. If the absorbance value is too high for this element, repeat the conditioning program.

W3.5

Warning: UV Radiation – Risk of Eye Damage

When the graphite furnace is heated to incandescence, e.g. during the atomization step, the furnace can emit UV radiation which can damage your eyes.

- *Always wear UV-absorbing safety glasses when looking at the furnace.*

W6.1

Warning: Toxic Gases

If you use nitrogen as the inert gas, toxic cyanogen gas $(CN)_2$ *will be produced when the furnace temperature is above 2300 °C.*

- *Make sure that the main laboratory fume ventilation system removes all gases and fumes emitted by the furnace.*

1. On the **Toolbar**, click on **Furnace**.
2. In the **Furnace Control** window, click on **Condition Tube**.
   The system uses a special furnace program to heat the tube to successively higher temperatures.
3. Check the alignment of the furnace autosampler.

To heat the graphite furnace manually

Note: *Do not heat the graphite furnace for longer than about 10 s when the temperature exceeds 2000 °C. Heating for longer periods will markedly reduce the lifetime of the graphite tube.*

1. On the **Toolbar**, click on **Furnace**.
2. In the **Furnace Control** window, click on the **Cleanout Temp.** entry field and enter the required temperature (e.g. 2500 °C).
3. Click on **Start** to heat the furnace.
   The furnace is heated to the selected temperature.
4. After 5–10 s, click on **Start** again to stop furnace heating.

To clean the contact surfaces of the graphite tube and contacts

W4.3

Warning: High Temperatures – Risk of Burns

The graphite furnace can generate very high temperatures.

- *Do not touch any parts of the furnace, especially the graphite components, until they have cooled to room temperature.*

1. Open the furnace and use the grips to remove the graphite tube (*procedure: page 3-5*).
2. Use a dry, clean swab to clean the contact surfaces of the graphite tube. If the surfaces of the graphite tube are pitted or cracked, discard the graphite tube and use a new one.
3. Use a dry, clean swab to clean the inside of the contacts, especially around the apertures where the radiation beam enters and exits.

   Be careful not to scratch the inner surfaces of the contacts.

   Remove any particles from inside the contacts.
   Use a stream of clean compressed air to blow out any particles from inside the contacts. **Wear safety glasses when doing this.**

   If the surfaces of the contacts are pitted or cracked, remove the contacts and install new ones (*procedure: page 3-14*).
4. Use the grips to insert the graphite tube into the rear contact and close the furnace (*procedure: page 3-7*).
5. Heat out the graphite tube to remove contamination (*procedure: page 3-10*).

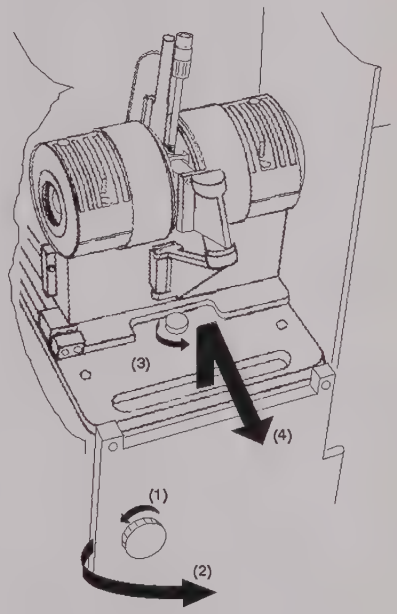
Moving the furnace in and out of the atomizer compartment

To pull the furnace forward

You do not need to remove the autosampler from the furnace door.

1. Release the locking screw that holds the furnace door closed (**1**).
2. Swing the door fully open (**2**).
3. Loosen the baseplate locking screw (**3**).
4. Grip the handle of the baseplate, lift the baseplate slightly, then, carefully pull the furnace forward to the stop (**4**).

   Do not try to pull the furnace farther than the stop.



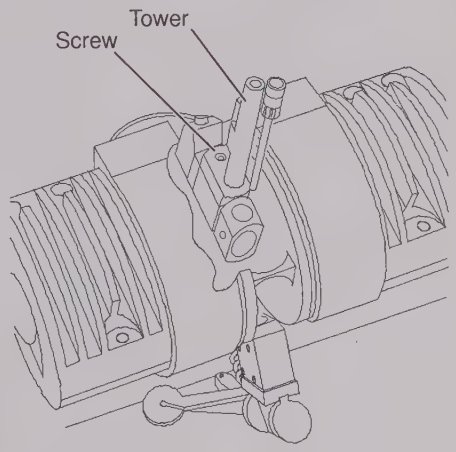
To push the furnace back

1. Grip the handle of the baseplate, lift the baseplate slightly, then push the furnace back as far as it will go.
2. Tighten the baseplate locking screw securely by hand.
3. Close the furnace door and tighten the locking screw.

Removing the fume extraction unit tower

1. Pull the furnace forward (*procedure: page 3-12*).
2. Use the special driver provided to loosen the screw that secures the tower to the rear contact housing.

   Move the tower to the side; be very careful not to damage the graphite nozzle.



To replace the tower

1. Place the tower carefully onto the rear contact housing.
2. Securely tighten the screw.

Changing the graphite contacts

Change the graphite contacts when one or both contacts are badly contaminated or show visible pits and small cracks. Always change both contacts at the same time.

W4.3

Warning: High Temperatures – Risk of Burns

The graphite furnace can generate very high temperatures.

- *Do not touch any parts of the furnace, especially the graphite components, until they have cooled to room temperature.*

Summary of the procedure

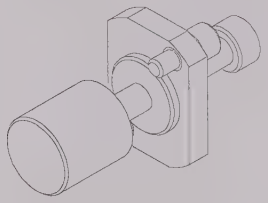
1. Pull the furnace forward (*procedure: page 3-12*).
2. Open the furnace and remove the graphite tube (*procedure: page 3-5*).
3. Remove the fume extraction unit from the rear contact housing (*procedure: page 3-13*).
4. Remove the front contact (*procedure: page 3-15*).
5. Remove the rear contact (*procedure: page 3-17*).
6. Insert a new front contact (*procedure: page 3-19*).
7. Insert a new rear contact (*procedure: page 3-21*).
8. Attach the fume extraction unit to the rear contact housing (*procedure: page 3-13*).
9. Insert the graphite tube and close the furnace (*procedure: page 3-7*).
10. Push the furnace back into the atomizer compartment (*procedure: page 3-12*).
11. Condition the graphite tube (*procedure: page 3-10*).
12. Align the furnace autosampler, see the guide: *Setting Up and Performing Analyses*.

Special tools to change the contacts are provided with the furnace.

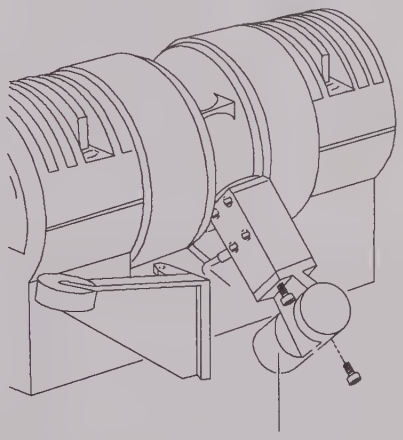
To remove the front contact

1. **See page 3-14 for the steps to perform before you remove the contacts.**
2. From the tools provided, you require the contact removal tool, the hex-driver, and the special driver with a star-shaped cross-section.

Contact removal tool

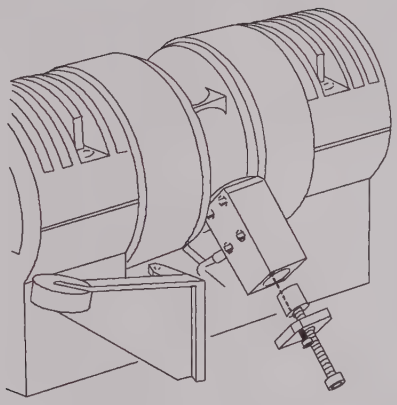


3. Loosen the two socket-head screws that secure the pressure cylinder to the front contact housing.
   Carefully pull the pressure cylinder out of the front contact housing. Make sure that you do not damage the O-ring.
   Put the pressure cylinder and screws in a safe place.



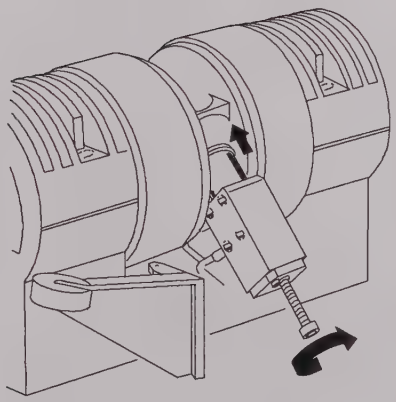
Pressure cylinder

4. Attach the removal tool to the front contact housing with the two captive screws on the tool.



Removal tool

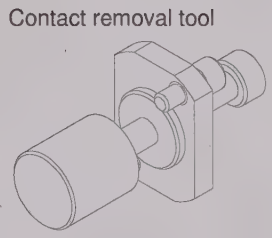
5. Use the hex-driver to screw the bolt on the removal tool into the tool to push out the contact.



6. Unscrew the two screws that secure the tool to the contact housing and remove the tool.

To remove the rear contact

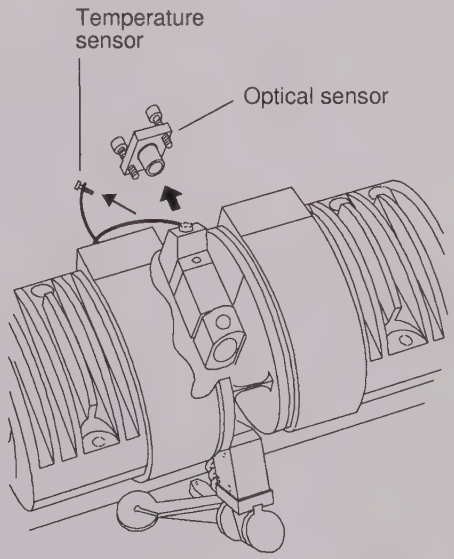
1. **See page 3-14 for the steps to perform before you remove the contacts.**
2. From the tools provided, you require the contact removal tool, the short hex-driver, and the special driver with a star-shaped cross-section.



3. Unscrew the socket-head screw that secures the temperature sensor to the rear contact housing.

   Note: *To avoid damaging the sensor, do not strain or twist the connection between the sensor cable and the cable shoe.*

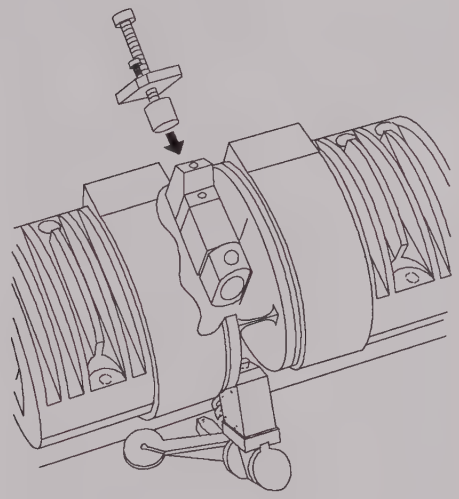
   Carefully move the sensor to the side.
   Save the screw and any washers.



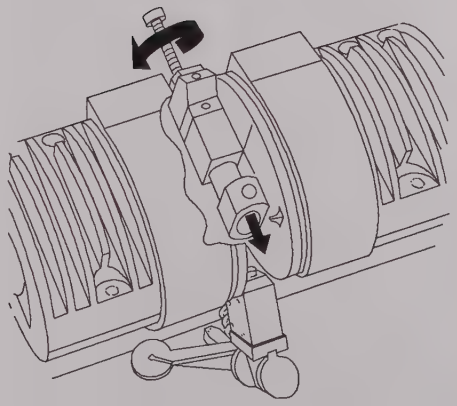
4. Unscrew the two captive, socket-head screws that secure the optical sensor to the rear contact housing.

   Carefully pull the optical sensor out of the rear contact housing. Make sure that you do not damage the O-ring.
   Move the optical sensor to the side.

5. Attach the removal tool to the rear contact housing with the two captive screws on the tool.



6. Use the hex-driver to screw the bolt on the removal tool into the tool to push out the contact.



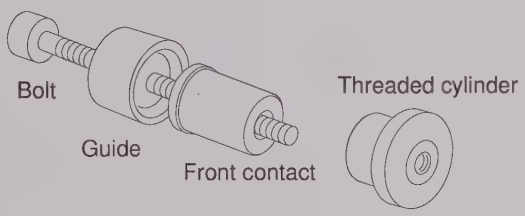
7. Unscrew the two screws that secure the tool to the contact housing and remove the tool.

7

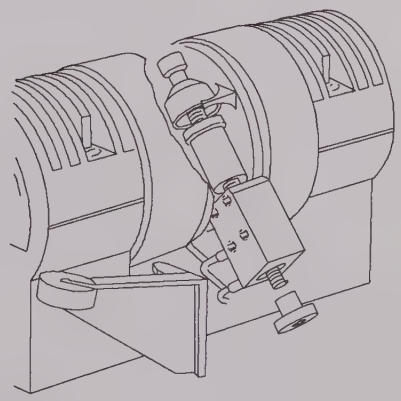
To insert the front contact

Note: *Do not scratch the new contact and do not touch it directly. Perspiration can contaminate the contact and cause poor analytical results.*

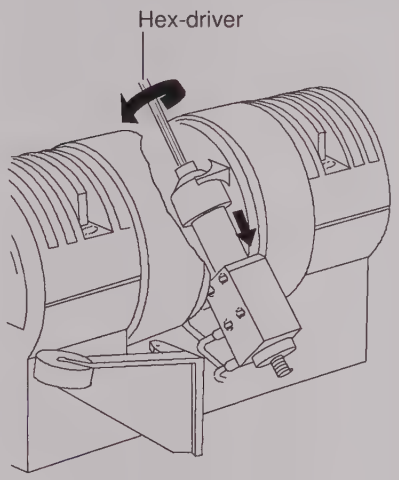
1. Make sure that the contact housing is completely clean and free from particles. If necessary, blow out any graphite particles from the contact housing with clean, dry compressed air.
   Wear safety glasses when doing this.
2. From the tools provided, you require:
   - the hex-driver and the special driver with a star-shaped cross-section.
   - the long bolt, front contact guide, and threaded cylinder as shown below.
3. Slide the guide and the front contact onto the long bolt as shown.



4. Put the bolt into the front contact housing such that the new contact sits in the opening of the housing.
5. Put the threaded cylinder into the opposite end of the contact housing and screw the bolt into the cylinder until the contact is pressed up against the housing.



6. Use the hex-driver to screw the bolt into the threaded cylinder and push the contact into the contact housing.
   Screw in the bolt until the rim of the contact is flush with the contact housing.



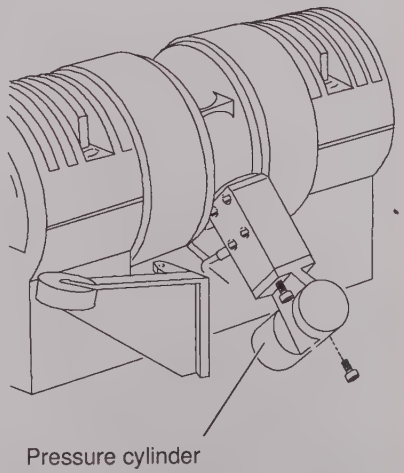
Note: *There must be no gap between the rim of the contact and the housing.*
Do not use excessive force to push the contact into the housing otherwise the contact may shatter. If there is substantial resistance, check that the parts are aligned correctly.

7. Screw the bolt out of the threaded cylinder and carefully remove the tools.

   Note: *Do not scratch the contact when you remove the tools.*

8. Blow out any graphite particles from the contact housing with clean, dry compressed air. **Wear safety glasses when doing this**.

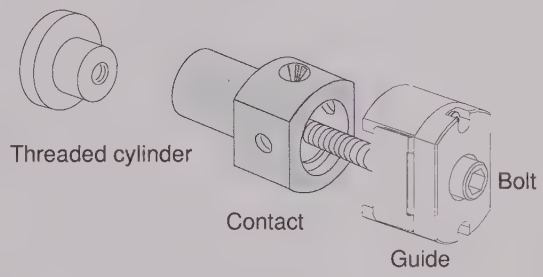
9. Check the O-ring on the pressure cylinder; if it is damaged, fit a new one. See *Chapter 7, Parts and Supplies* for the part number.
10. Push the pressure cylinder carefully into the front contact housing. Make sure that you do not damage the O-ring.
11. Tighten the two screws to secure the pressure cylinder to the front contact housing.



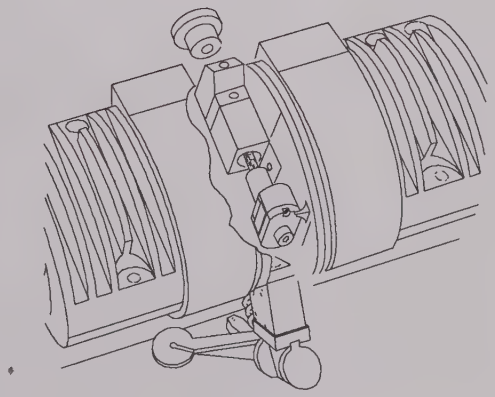
To insert the rear contact

Note: *Do not scratch the new contact and do not touch it directly. Perspiration can contaminate the contact and cause poor analytical results.*

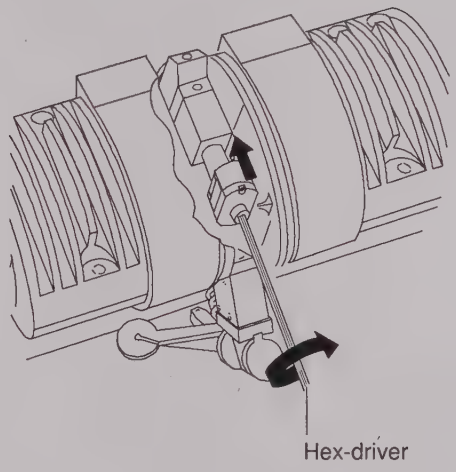
1. Make sure that the contact housing is completely clean and free from particles. If necessary, blow out any graphite particles from the contact housing with clean, dry compressed air.
   Wear safety glasses when doing this.
2. From the tools provided, you require:
   - the hex-driver and the special driver with a star-shaped cross-section.
   - the long bolt, rear contact guide, and threaded cylinder as shown below.
3. Slide the rear contact into the guide and slide these two parts onto the long bolt as shown.



4. Put the bolt into the front contact housing such that the new contact sits in the opening of the housing.
   Make sure that the graphite contact is correctly orientated, with the sample injection hole at the top.
5. Put the threaded cylinder into the opposite end of the contact housing and screw the bolt into the cylinder until the contact is pressed up against the housing.



6. Use the hex-driver to screw the bolt into the threaded cylinder and push the contact into the contact housing.
   Screw in the bolt until the contact is flush with the contact housing.



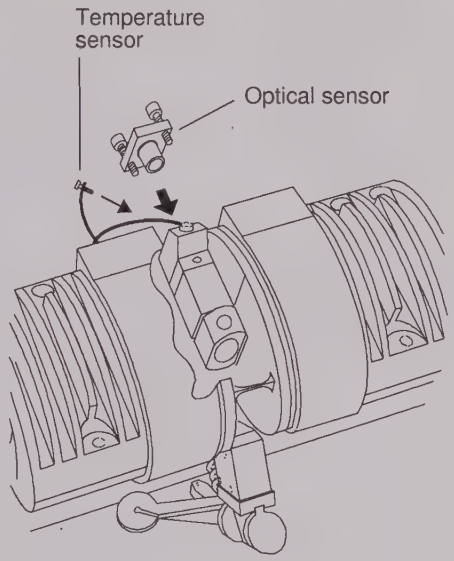
Note: *There must be no gap between the contact and the housing.*
Do not use excessive force to push the contact into the housing otherwise the contact may shatter.
If there is substantial resistance, check that the parts are aligned correctly.

7. Screw the long bolt out of the threaded cylinder and carefully remove the tools.

   Note: *Do not scratch the contact when you remove the tools.*

8. Blow out any graphite particles from the contact housing with clean, dry compressed air. **Wear safety glasses when doing this.**

9. Check the O-ring on the optical sensor; if it is damaged, fit a new one. See *Chapter 7, Parts and Supplies* for the part number.
10. Push the optical sensor into the rear contact housing. Make sure that you do not damage the O-ring.
11. Tighten the two screws to secure the optical sensor to the rear contact housing.
12. Attach the temperature sensor to the top of the rear contact housing. Use the original screw and spring washer.



Note: *To avoid damaging the sensor, do not strain or twist the connection between the sensor cable and the cable shoe.*

13. See page 3-14 for a summary of the steps to perform after you have installed the contacts.

Checking and cleaning the furnace windows

The quartz furnace windows seal the ends of the furnace where the radiation beam enters and exits. Over a period of time sample constituents can accumulate on the windows. This reduces the intensity of the radiation and the sensitivity and precision of the analytical results.

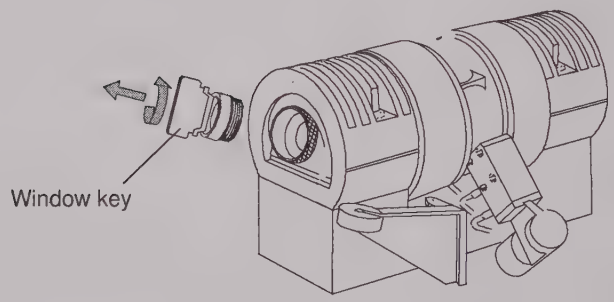
Remove the windows and clean them regularly. How frequently depends on the type of samples that are being analyzed.
If you analyze samples that have 'dirty' matrices, such as blood, sugar or oil, you will probably have to clean the furnace windows more often than if you were analyzing 'clean' samples, such as drinking water.

Caution: Risk of damage to the furnace windows

The quartz windows are precision optical components; handle them carefully to prevent scratches, fingerprints or other contamination.

To remove the windows

1. Make sure that the furnace is cool.
2. Pull the furnace forward (*procedure: page 3-12*).
3. Use the key provided to unscrew the left-hand and the right-hand windows from the furnace.



To refit the windows

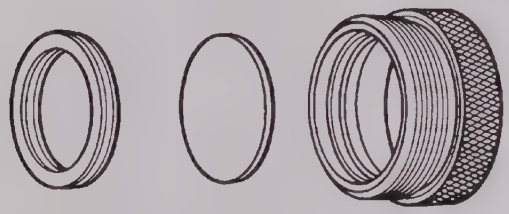
1. Screw each window carefully into the ends of the furnace; make sure that the threads are properly engaged.

   The windows are designed to be slightly offset from the vertical.

2. Push the furnace back into the atomizer compartment (*procedure: page 3-12*).

To clean the windows

1. Remove the windows from the furnace.
2. Dismantle the window assemblies and carefully remove the quartz windows from the mounts.



3. Blow any dust or particles off the window surface with clean dry air before you start.
4. Clean the windows carefully with a tuft of cotton moistened with a dilute solution of mild laboratory detergent.
   Rinse the windows several times with deionized water.
   If the windows are not clean after this procedure, clean them with a soft lint free cloth moistened with spectroscopic grade alcohol.

   Note: *To avoid scratching the windows, rub the surfaces of the windows as little as possible. Discard scratched windows.*

5. Reassemble the windows.
   New seals and windows are available.
6. Screw the windows in the furnace.

Aligning the Furnace

The furnace is aligned at the factory and the service engineer checks the alignment as part of the installation procedure.
Normally you should never need to align the furnace, but a situation might arise where the furnace is shifted slightly in the radiation beam.
Before you align the furnace, for example because the energy transmitted through the furnace is low, make sure that:

- The lamp is aligned correctly and operating at the recommended current setting.
- The furnace windows are clean and screwed in correctly.
- There is nothing obstructing the radiation beam inside or outside the furnace.

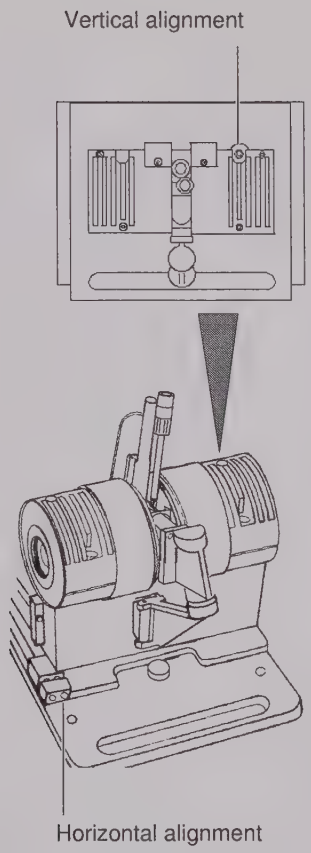
To align the furnace

1. Install a graphite tube and close the furnace (*procedure: page 3-7*).
2. Pull the furnace forward (*procedure: page 3-12*).
3. Align the lamp.
    1. Display the Align Lamps window:
    On the **Toolbar**, click on **Lamps**.
    2. In the **Beam Combiner** entry field, select **1 Lamp mode**.
    3. Align the lamp in location 1.
4. Push the furnace back into the atomizer compartment (*procedure: page 3-12*).

5. Use the two alignment screws to align the furnace to obtain the maximum reading in the Align Lamps window.

   You should find that the reading shows a wide maximum for a large part of the adjustment range of the screws – especially the horizontal alignment.

   – Set the screws to the mid-point of the adjustment range that gives the maximum reading.



Autosampler Maintenance

4

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Introduction

W1.2

Warning: Unauthorized Adjustments and Servicing

Only a Perkin-Elmer service engineer or similarly trained and authorized person should be permitted to service the instrument.

- *Do not attempt to make adjustments, replacements, repairs, or modifications to this instrument except as described in the documentation supplied with the instrument.*

If the autosampler will not function correctly...

- Switch off the spectrometer system and make sure it cannot be operated.
- Contact your local Perkin-Elmer office.

You should only perform the maintenance procedures described in this handbook. For any other maintenance or service contact your local Perkin-Elmer office to arrange for a service engineer to visit.
In particular you should only allow a Perkin-Elmer service engineer or similarly trained and authorized person to perform any work on:

- Electrical components inside the instrument;
- The gas connections and gas system pneumatics;

Before the service engineer arrives:

1. Make sure that the instrument and work area are clean.
2. Empty the furnace autosampler waste bottle.

Troubleshooting

See the *Troubleshooting* guide supplied with the system. This includes information about problems that can arise with both the software and the spectrometer system.

Routine maintenance checklist

The autosampler is a precision instrument constructed from high quality components. It is capable of dispensing volumes of liquid in the microliter range. To maintain this high level of performance, you must treat the autosampler with due care.

Autosampler, maintenance checklist	
Autosampler external surfaces	Wipe over the surfaces with a lint-free cloth moistened with a dilute solution of laboratory detergent. The autosampler surfaces are resistant to dilute acids and alkalis, and to a lesser extent to strong acids and alkalis and organic solvents.
Complete rinsing system	Prime the rinsing system before the start of every analysis run. Flush the rinsing system when you have finished an analysis run.
Valves	The valves must function correctly to maintain the precision of the dispensed volumes. If the precision of the analytical results deteriorates, this can be an indication that a valve is not functioning correctly. If a valve seizes or leaks, for example because the pump has been idle for a long time, or because of particles lodged in the valve, or because of worn seals, you can remove the valves to clean or change them (*procedure: page 4-5*).
Waste bottle	Empty the autosampler waste bottle regularly. Never allow it to overflow or allow the liquid to reach the end of the drain tube. If the bottle contains hazardous, toxic, or flammable substances, dispose of the waste properly, according to the local safety regulations.
Rinse bottle	Make sure that the rinse bottle is always filled with clean, **filtered** rinsing fluid.
All tubes	Make sure that all the tubes are clean and free from kinks. Change any tubes that may be damaged or contaminated.
Pipet tip	Make sure that the pipet tip is not damaged. If the tip is damaged you may get pipetting errors during the analyses. Repair the tip or install a new pipet assembly if necessary (*procedure: page 4-13*).
Pump heads	Make sure that the pump heads are not loose. Tighten the pump head retaining ring if necessary. Make sure that the pump head remains vertical, with the arrow aligned vertically (*procedure: page 4-18*).

Valve maintenance

The autosampler pumps dispense microliter volumes of liquid with high precision. To maintain this high precision it is essential that the valves function correctly. If there is a deterioration in the precision of the analytical results, and other sources of error can be excluded, this is an indication that a valve may not be functioning correctly.

Only the rinse pump contains valves. The sample pump contains inserts that are a similar shape to the rinse pump outlet valve.

Routine maintenance

The only routine maintenance that the valves require is to flush them thoroughly before and after every analysis.

Flushing the valves and rinsing system

1. Make sure that the rinsing system components are correctly installed, in good condition, and suitable for the rinsing fluid you will use.
2. Prepare the rinsing solutions that you require, see below.
3. Fill the rinse bottle with the first, clean, particle-free, rinsing fluid.

   If there are particles in the rinsing fluid they can lodge in the valves, causing leaks and non-reproducible results.
4. In the **Furnace Control** window, click on **Flush Sampler** as often as required to completely fill the rinsing system with rinsing fluid and flush all the air out.
5. Empty the waste bottle. Dispose of any hazardous waste correctly.
6. Repeat steps 2 through 4 for each rinsing solution.

   Note: *Make certain there are no air bubbles in the rinsing system. Air bubbles can lead to non-reproducible results.*

Rinsing solutions

Use the following rinsing solutions:

After an analysis series:

1. If you have been using an organic rinsing fluid, use isopropanol or other water-miscible solvent.
2. Dilute nitric acid. This is especially important for elements with a tendency to carryover.
3. Isopropanol.
4. Deionized water.

Before the start of every analysis series:

If the rinsing solution you intend to use is miscible with the solution in the system, use your intended rinsing solution. If the rinsing solution you intend to use is not miscible with the solution in the system, you must use intermediate rinsing fluids. For example, to change from an acidic fluid to an organic solvent, you could use:

1. Deionized water.
2. Isopropanol or other water-miscible solvent.
3. Final organic solvent.

Before performing maintenance on the system:

1. Isopropanol.
2. Deionized water.

After performing maintenance on the system:

1. Isopropanol.
2. The rinsing solution you intend to use next, or deionized water.

Checking the valves

If you experience problems such as poor precision or recovery, check to see if the rinse pump valves are leaking; the procedure is described below.

If a valve is leaking, clean it as described on the following pages. If cleaning does not remedy the problem, replace the complete valve.

Note: *Do not attempt to repair the valves or change individual components inside the valve. If any components are damaged or worn, discard the valve and install a complete, new valve.*

Caution: Risk of damage to the autosampler

You can cause irreparable damage to the gears if you attempt to move the autosampler arm by hand.

- *Never attempt to move the autosampler arm by hand.*

To check the outlet valve

1. Use the depth stop control to raise the pipet tip out of the rinsing port.
2. In the **Furnace Control** window, click on **Flush Sampler**.
   The rinsing pump performs three cycles. During the suction phase of each cycle (pump plunger moves backward) a droplet of rinsing fluid hangs on the end of the pipet tip; this droplet must remain stationary.
   At the end of a rinse cycle the sample pump draws the rinsing fluid droplet back into the pipet tip.

To check the inlet valve

1. In the **Furnace Control** window, click on **Flush Sampler**.
2. Remove the rinse feed tube briefly from the rinsing fluid so that an air bubble is drawn in and then replace the tube in the rinsing fluid.
3. Watch the meniscus of the air bubble: It must remain stationary during the expulsion phase of each cycle (pump plunger moves forward).
4. Thereafter repeat the rinse cycle as often as required to remove air bubbles. Remove persistent bubbles by flushing the system first with isopropanol and then with aqueous rinsing fluid.

Removing the rinse pump valves and sample pump tube connectors

Note: *Avoid handling the internal valve components with bare fingers as much as possible—grease from your fingers can interfere with the correct functioning of the valves. Wear suitable gloves.*

Caution: Risk of damage to the autosampler

You can cause irreparable damage to the gears if you attempt to move the autosampler arm by hand.

- *Never attempt to move the autosampler arm by hand.*

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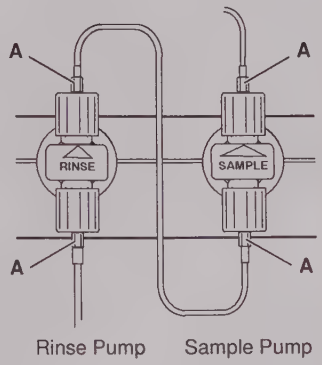
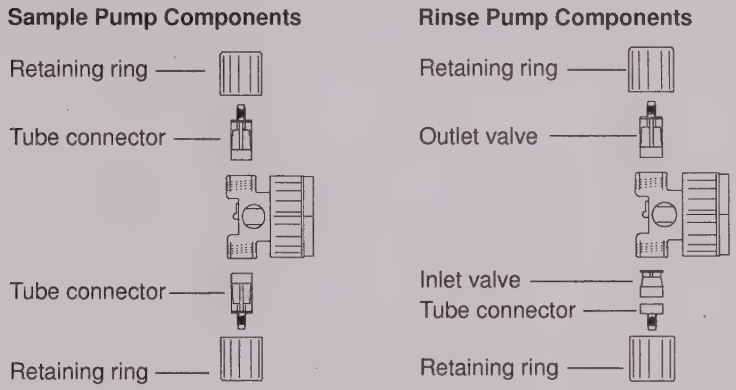
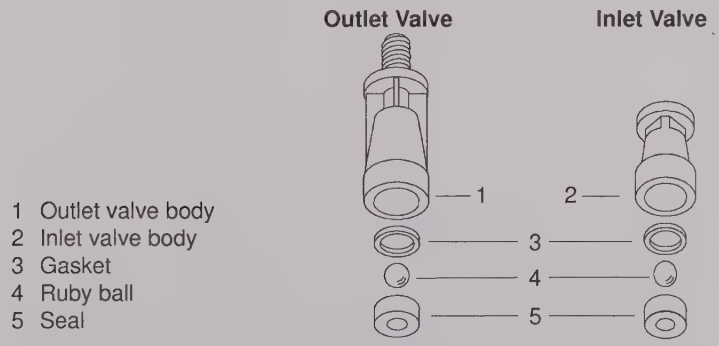
1. Disconnect the tubes from the pumps. When you unscrew the nuts—**A**, make sure that you do not lose any of the ferrules from the ends of the tubes.



2. Unscrew the valve retaining rings.
   Carefully withdraw the valves from the rinse pump or the tube connectors from the sample pump. Be very careful not to lose any of the parts from inside the valves.



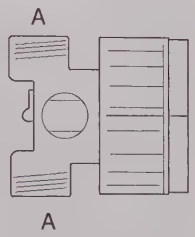
3. Remove the components from inside the rinse pump valves.
   Do not use sharp or pointed tools to remove them.
   Handle the seals with especial care; they are very **delicate** and easily damaged.
   Keep the components from the different valves separate.



Cleaning the valves, tube connectors and pump heads

Note: *Never use any sharp tools to clean the pump components. Avoid handling the internal valve components with bare fingers as much as possible—grease from your fingers can interfere with the correct functioning of the valves. Wear suitable gloves.*

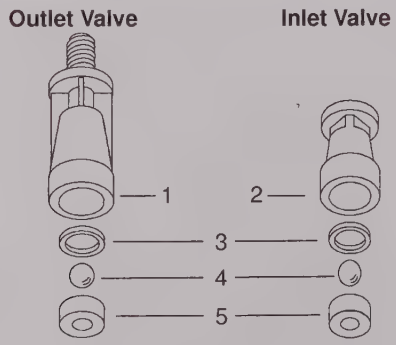
1. Clean the valve components in an ultrasonic bath.
   Use a dilute solution of laboratory detergent.
   Rinse them thoroughly with deionized water.
2. Rinse the sample pump tube connectors thoroughly with deionized water.
3. Rinse the inlet and outlet chambers — **A** of the pump heads thoroughly with deionized water.



Note: *Do not remove the pump heads from the pumps. This operation should only be performed by a Perkin-Elmer service engineer or similarly trained person.*

Assembling and installing the valves

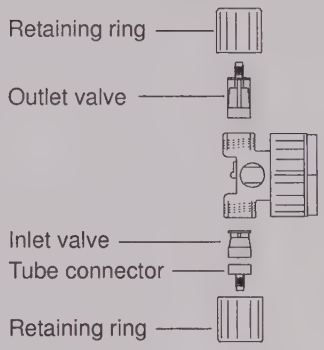
1. If any of the valve components are damaged or worn, discard the valve and install a complete, new valve.
2. Reassemble the valves.
   Do not mix components from different valves. Make sure that the shiny side of the seal is directed toward the ruby ball.



1 Outlet valve body
2 Inlet valve body
3 Gasket
4 Ruby ball
5 Seal

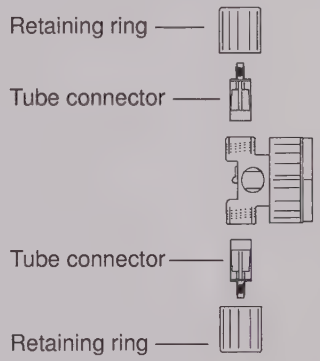
3. Place the valves and tube connector in the rinse pump head. Screw on the retaining rings finger-tight. Do not use tools or overtighten the retaining rings; this may deform the seals and cause leaks.
   Make sure that you use the outlet valve, which has a black seal, and not one of the sample pump tube connectors.
   Make sure that the black seal of the inlet valve faces the tube connector.

Rinse Pump Components

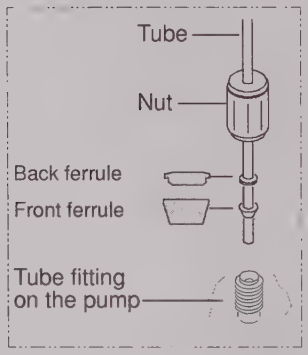


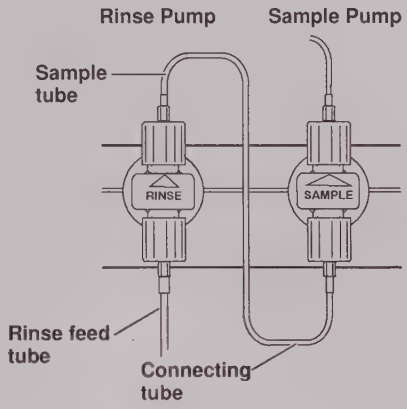
4. Place the tube connectors in the sample pump head.
   Make sure that you do not use the rinse pump outlet valve which has a black seal.
5. Screw on the retaining rings finger-tight. Do not use tools or overtighten the retaining rings; this may deform the connections and cause leaks.
6. Make sure that all the tubes in the rinsing system are clean before you reconnect the tubes to the pumps.

Sample Pump Components



7. Reconnect the tubes to the correct sides of the pumps.
   Make sure that the ferrules are positioned correctly.
   Screw on the nuts firmly by hand; do not use any tools.
   The rinse feed tube has a larger diameter than the other tubes and uses larger ferrules and a larger nut.





8. Make sure that the pump heads are correctly aligned (*procedure: page 4-18*).
9. Prime and flush the rinsing system (*procedure: page 4-5*):
   1. Flush the rinsing system with isopropanol.
   2. Flush the rinsing system well with the usual rinsing fluid.

Note: *Always prime and flush the rinsing system after you have performed any work on the components.*

Repairing a pipet

The complete pipet is an assembly consisting of the sample tube fitted through a mount and a flexible sleeve. The mount is provided with a groove that locates the mount in the correct position in the clip at the end of the autosampler arm. The pipet tip is that portion of the sample tube protruding from the flexible sleeve. If the pipet tip becomes damaged you can repair it as given below:

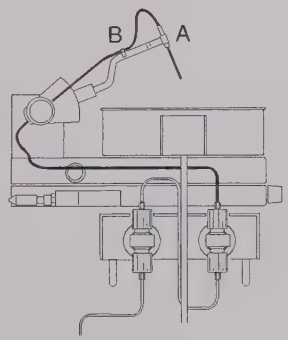
Caution: Risk of damage to the autosampler

You can cause irreparable damage to the gears if you attempt to move the autosampler arm by hand.

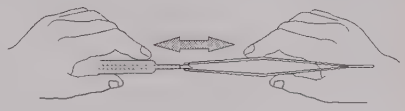
- *Never attempt to move the autosampler arm by hand.*

---

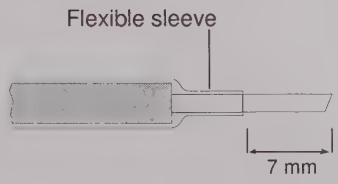
1. Raise the pipet tip out of the rinsing port:
   1. In the **Furnace Control** window, click on **Align Tip**. The Align Autosampler dialog appears.
   2. In this dialog, click on **Unlocked**. The pipet tip rises to a position directly above the rinsing port.
2. Pull the mount out of the clip at the end of the autosampler arm — **A**.
3. Remove the clip securing the sample tube to the autosampler arm — **B**. Save the clip.



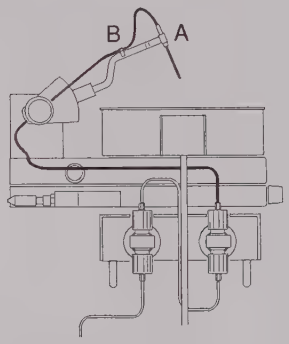
4. Hold the mount in one hand and the end of the damaged pipet tip, with grips, in the other hand. Pull the tube through the mount until approximately 10 mm of undamaged PTFE tube are outside the flexible sleeve



5. Using a sharp blade, cut off the PTFE tube at a slight angle to leave approximately 7 mm of tube extending out of the sleeve.



6. Push the mount into the clip at the end of the autosampler arm — **A**. Make sure that the groove in the mount fits correctly in the clip.
7. Refit the clip securing the sample tube to the autosampler arm — **B** such that it forms a smooth loop from the mount.



8. In the **Align Autosampler** dialog, click on **Exit**.
9. Prime and flush the rinsing system (*procedure: page 4-5*):
    1. Flush the rinsing system with isopropanol.
    2. Flush the rinsing system well with the usual rinsing fluid.
10. Align the autosampler as described in *Setting Up and Performing Analyses*.

Installing a new pipet assembly

The complete pipet is an assembly consisting of the sample tube fitted through a plastic mount. The mount is provided with a groove that locates the mount in the correct position in the clip at the end of the autosampler arm. The pipet tip is that portion of the sample tube protruding from the mount.
If the pipet tip becomes damaged and cannot be further repaired or if the sample tube is kinked or contaminated, you should replace the complete assembly.

Caution: Risk of damage to the autosampler

You can cause irreparable damage to the gears if you attempt to move the autosampler arm by hand.

- *Never attempt to move the autosampler arm by hand.*

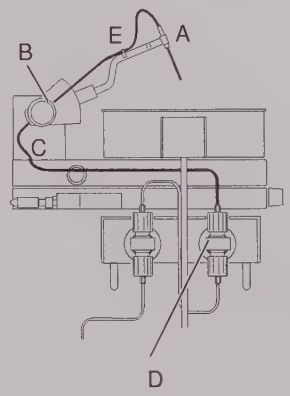
To remove the old pipet assembly

1. Raise the pipet tip out of the rinsing port:
    1. In the **Furnace Control** window, click on **Align Tip**.
    The Align Autosampler dialog appears.
    2. In this dialog, click on **Unlocked**. The pipet tip rises to a position directly above the rinsing port.
2. Remove the pipet assembly:
    1. Unscrew the knurled nut that connects the sample tube to the sample pump. Remove the nut and ferrules from the tube and save the nut.
    2. Remove the clip securing the sample tube to the autosampler arm.
    3. Pull the mount out of the clip at the end of the autosampler arm.
    4. Remove the entire sample tube from the sample table.

To install the new pipet assembly

Note: *Handle the sample tube with care. Do not damage the delicate pipet tip and do not kink the tube.*

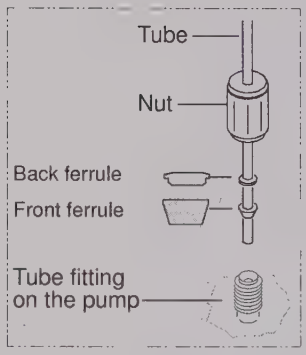
1. Push the mount into the clip at the end of the autosampler arm — **A**.
   Make sure that the groove in the mount fits correctly in the clip.
2. Thread the sample tube:
   1. Through the hole in the spindle of the sampler arm control wheel — **B**;
   2. Around the hooks on the sample table — **C**;
   3. To the top of the sample pump — **D**.
3. Using the clip you saved when removing the pipet assembly, clip the sample tube onto the autosampler arm such that it forms a smooth loop from the mount to the clip — **E**.

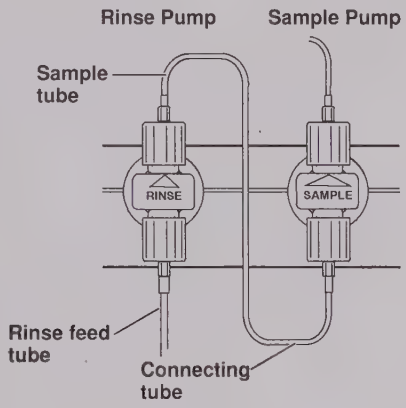


4. Take two new ferrules from the ferrule kit provided with the autosampler. Slide the knurled nut, the back ferrule, and then the front ferrule onto the tube.

   Note: *Make sure the ferrules are the correct way round.*

5. Screw the knurled nut finger-tight onto the sample pump. Do not use force.





6. In the **Align Autosampler** dialog, click on **Exit**.
7. Prime and flush the rinsing system (*procedure: page 4-5*).
   1. Flush the rinsing system with isopropanol.
   2. Flush the rinsing system well with the usual rinsing fluid.
8. Align the autosampler as described in *Setting Up and Performing Analyses*.

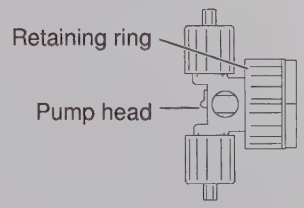
Aligning the pump heads

To align the pump heads

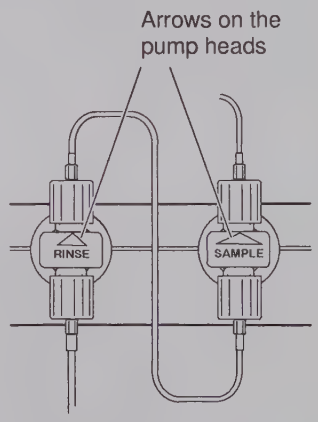
1. Use the special wrench provided to loosen the retaining ring that secures the pump head.
2. Set the pump head so that the molded arrow is pointing upward. The pump head has a lug that engages in a notch on the pump mount when the pump head is set correctly.
3. Use the special wrench provided to tighten the retaining ring. Do not use excessive force.

Note: *Do not remove the pump heads from the pumps. This operation should only be performed by a Perkin-Elmer service engineer or similarly trained person.*

Side view of pump



Front view of pumps



Fume Extraction Unit Maintenance 5

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Introduction

W1.2

Warning: Unauthorized Adjustments and Servicing

Only a Perkin-Elmer service engineer or similarly trained and authorized person should be permitted to service the instrument.

- *Do not attempt to make adjustments, replacements, repairs, or modifications to this instrument except as described in the documentation supplied with the instrument.*

If the system will not function correctly...

- Switch off the spectrometer system and make sure it cannot be operated.
- Contact your local Perkin-Elmer office.

You should only perform the maintenance procedures described in this handbook. For any other maintenance or service contact your local Perkin-Elmer office to arrange for a service engineer to visit.
In particular you should only allow a Perkin-Elmer service engineer or similarly trained and authorized person to perform any work on:

- Electrical components inside the instrument;
- The gas connections and gas system pneumatics;

Before the service engineer arrives:

1. Make sure that the instrument and work area are clean.
2. Empty the furnace autosampler waste bottle.

Troubleshooting

See the *Troubleshooting* guide supplied with the system. This includes information about problems that can arise with both the software and the spectrometer system.

Routine maintenance checklist

Fume extraction unit, maintenance checklist

If you analyze samples that have 'dirty' matrices, such as blood, sugar or oil, you will probably have to clean the components more often than if you were analyzing 'clean' samples, such as drinking water.

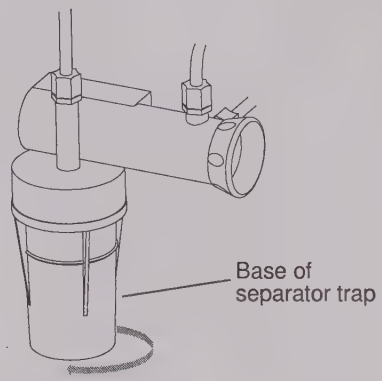
Clean all of the components before you leave the spectrometer standing idle for any length of time.

Note: *If obnoxious fumes are liberated from the furnace and they are not adequately trapped by the fume extraction unit, use a suitable length of tubing to connect the fume vent tube to a laboratory fume hood.*

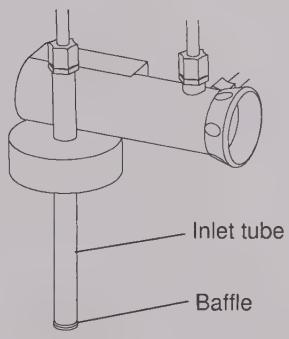
Separator trap	Refill with clean deionized water before each batch of samples (*procedure: page 5-5*). Make sure that there is a constant stream of bubbles from the inlet tube when the system is operating. Make sure that all of the connections are tight and that the baffle is clean.
Filter cartridge	Change the filter before each batch of samples (*procedure: page 5-6*).
Nozzle holder cavity	Clean when necessary (*procedure: page 5-7*). How often you need to do this depends on the type of samples being analyzed.
Graphite nozzle	Clean or change when necessary (*procedure: page 5-8*). How often you need to do this depends on the type of samples being analyzed.
Extraction pump	Clean the pump when necessary (*procedure: page 5-11*). How often you need to do this depends on the type of samples being analyzed.
Fume transfer tube	Clean or change when necessary (*procedure: page 5-13*). How often you need to do this depends on the type of samples being analyzed.

Refilling and cleaning the separator trap

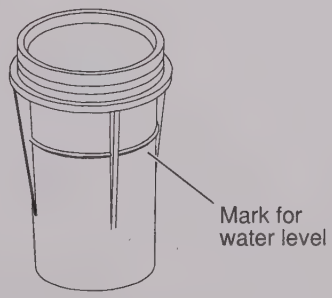
1. Carefully unscrew the base of the separator trap.
   Empty, and if necessary clean the trap.



2. Normally the perforated baffle is kept clean by the turbulence in the trap.
   To remove the baffle, hold the inlet tube securely and pull out the baffle. Clean the baffle if necessary, then push it back into the inlet tube.

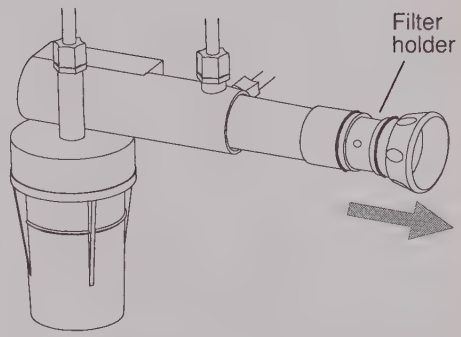


3. Fill the trap with clean deionized water up to the lower edge of the mark molded into the side of the trap.
4. If the O-ring on the trap is damaged, fit a new one.
   Screw the base back onto the trap. Make sure that the threads are properly engaged and that the trap is sealed.

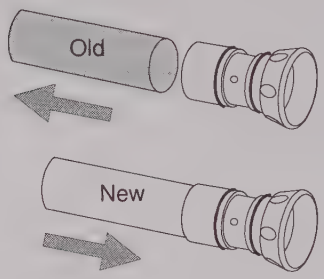


Changing the filter cartridge

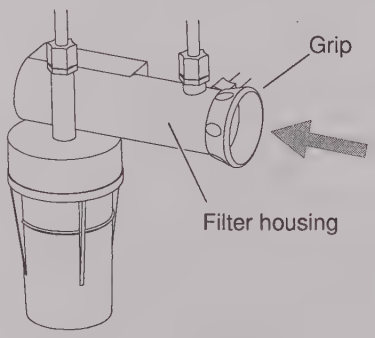
1. Pull the filter holder out of the housing with a slight twisting action.



2. Pull the filter cartridge out of the holder.
3. Push a new filter cartridge into the holder. Make sure that the filter cartridge butts up to the end of the holder. Do not kink the filter cartridge.
4. If an O-ring on the filter holder is damaged, fit a new one.



5. Push the filter holder into the housing with a slight twisting action. Make sure that the grip of the holder butts up to the housing.



Cleaning the cavity of the nozzle holder

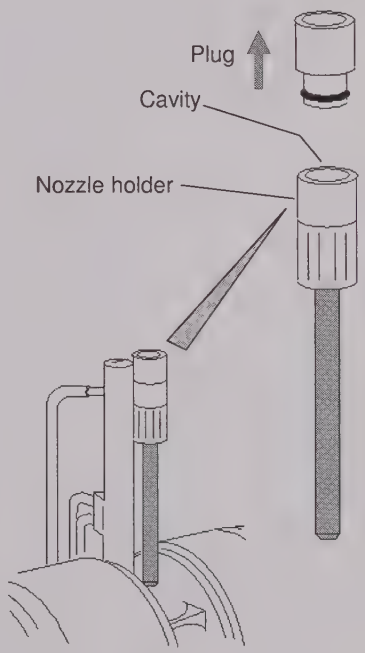
W4.3

Warning: High Temperatures – Risk of Burns

The graphite furnace can generate very high temperatures.

- *Do not touch any parts of the furnace, especially the graphite components, until they have cooled to room temperature.*

1. Make sure that a furnace program is not currently running and that the furnace is cool.
2. Grip the nozzle holder firmly with one hand and pull out the plug from the top of the nozzle holder with the other hand.
3. Clean the nozzle holder cavity with a lint-free swab.
4. Clean the lower end of the plug. If the O-ring is damaged, fit a new one.
5. Grip the nozzle holder firmly with one hand and push the plug back into the nozzle holder with the other hand.

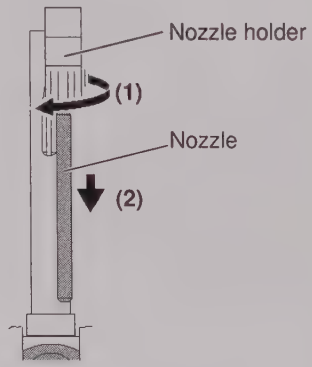


Removing and refitting the nozzle

Note: *The nozzle is a precision component made from graphite. Handle it carefully and protect the tip of the nozzle from damage. Do not grip it with any tool.*

To remove the nozzle

1. Make sure that a furnace program is not currently running and that the furnace is cool.
2. Grip the middle section of the nozzle holder firmly with one hand and slightly unscrew the lower part of the nozzle holder (**1**) with the other hand.
3. Carefully pull and twist the nozzle directly downward out of the holder (**2**).



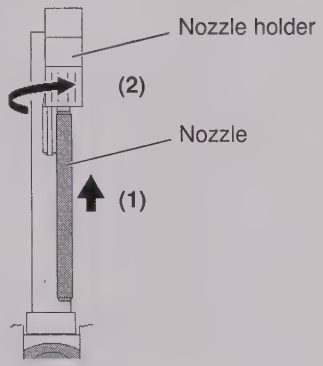
To clean the nozzle

1. Use a dilute solution of laboratory detergent, dilute acid, or deionized water to clean the nozzle.
   You can also use an ultrasonic bath.
2. Rinse the nozzle very thoroughly with deionized water.

To refit the nozzle

New O-rings for the nozzle holder are available.

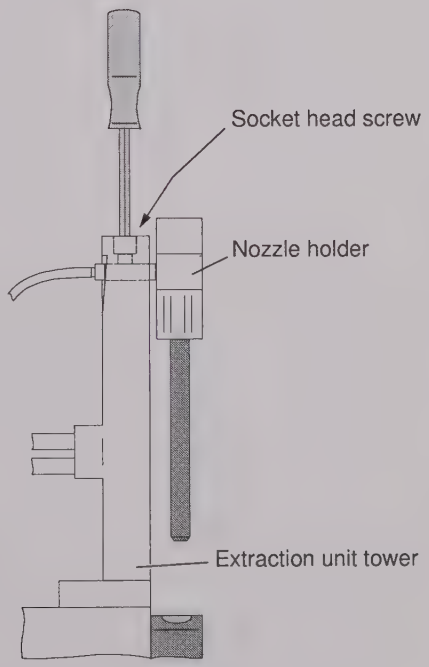
1. Grip the middle section of the nozzle holder firmly with one hand and carefully push the nozzle into the holder with the other hand. Keep the nozzle in line with the holder **(1)**.
2. Grip the middle section of the nozzle holder firmly with one hand and screw up the lower part of the nozzle holder with the other hand until the nozzle is held securely **(2)**.



Aligning the nozzle

1. Using a socket wrench, slacken the socket head screw in the top of the extraction unit tower by ¼ to ½ of a turn – no more – so that you can just move the nozzle holder.

   Note: *Do not slacken the socket head screw by more than ¼ to ½ of a turn, otherwise it may disengage from the notch in the clamp. When you then retighten the screw you may damage the nozzle holder.*



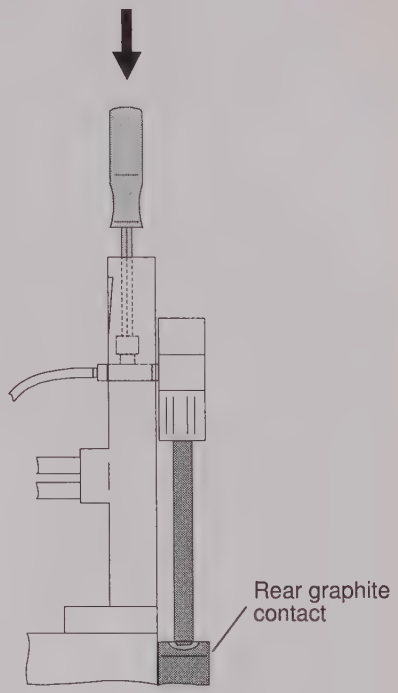
2. Hold the socket wrench vertically and carefully push the nozzle holder down.

   Guide the nozzle into the conical hole in the rear graphite contact. You may tilt the nozzle holder or move it slightly toward or away from the tower so that the nozzle enters the conical hole.

3. When you have aligned the nozzle correctly, tighten the socket head screw without allowing the nozzle to rise.

   Note: *Do not overtighten the socket head screw, you may damage the nozzle holder.*

4. Allow the nozzle to rise slowly, then remove the socket wrench.

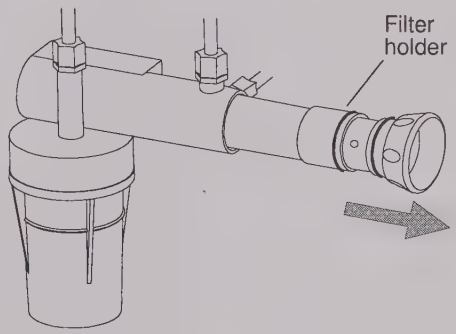


Cleaning the extraction pump

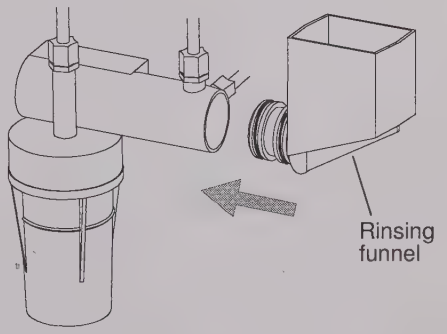
Clean the extraction pump:

- After you have analyzed 'dirty' samples such as blood, sugar, or oil.
- Before you leave the instrument standing idle for a longer period of time.

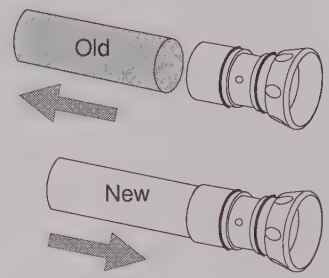
1. Place the end of the fume vent tube into a suitable plastic bottle (empty autosampler waste bottle or the like).
2. Pull the filter holder out of the housing with a slight twisting action.



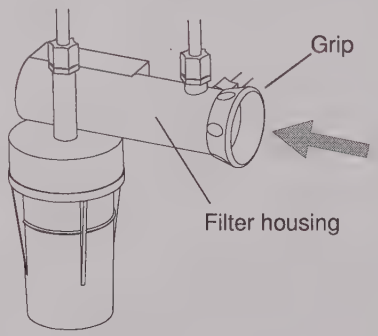
3. Push the rinsing funnel into the housing with a slight twisting action.
4. Fill the funnel with Athenae.
5. In AA WinLab, create a method that uses the fume extraction unit: In the **Method Editor**, on the **Furnace Page**:
   1. Create 2 steps each with **Ramp Time 60**, **Hold Time 60**, and **Temperature 50**.
   2. Create 1 step with **Ramp Time 1**, **Hold Time 1**, **Temperature 50**, and **Read** selected.
   3. Select **Use Fume Extraction Unit**.



6. In the **Furnace Control** window, click on **Furnace On/Off**.
   This starts the furnace program and the fume extraction pump.
   1. Repeat this step as often as required until all of the ethanol has been pumped through the extraction pump.
   2. When all of the ethanol has been pumped through the extraction pump, repeat this step to draw air through the extraction pump for about 4 minutes to dry the pump.
7. Pull the rinsing funnel out of the housing with a slight twisting action.
8. Push a new filter cartridge into the holder. Make sure that the filter cartridge butts up to the end of the holder. Do not kink the filter cartridge.
9. If the O-ring on the filter holder is damaged, fit a new one.



10. Push the filter holder into the housing with a slight twisting action. Make sure that the grip of the holder butts up to the housing.
11. Empty the bottle containing the waste ethanol.



Removing, cleaning and refitting the fume transfer tube

The fume transfer tube, which connects the nozzle to the separator trap, is the tube that is most likely to need cleaning or replacement. The tube is made from special inert FEP polymer. It becomes discolored during use. You can clean it as described below, or discard it and fit a new tube.

To remove the tube

1. Carefully pull the tube off the connector on the tower of the fume extraction unit.
2. Unscrew the knurled nut securing the transfer tube on the separator trap and remove the nut from the tube.
3. Remove the tube carefully from the atomizer compartment.

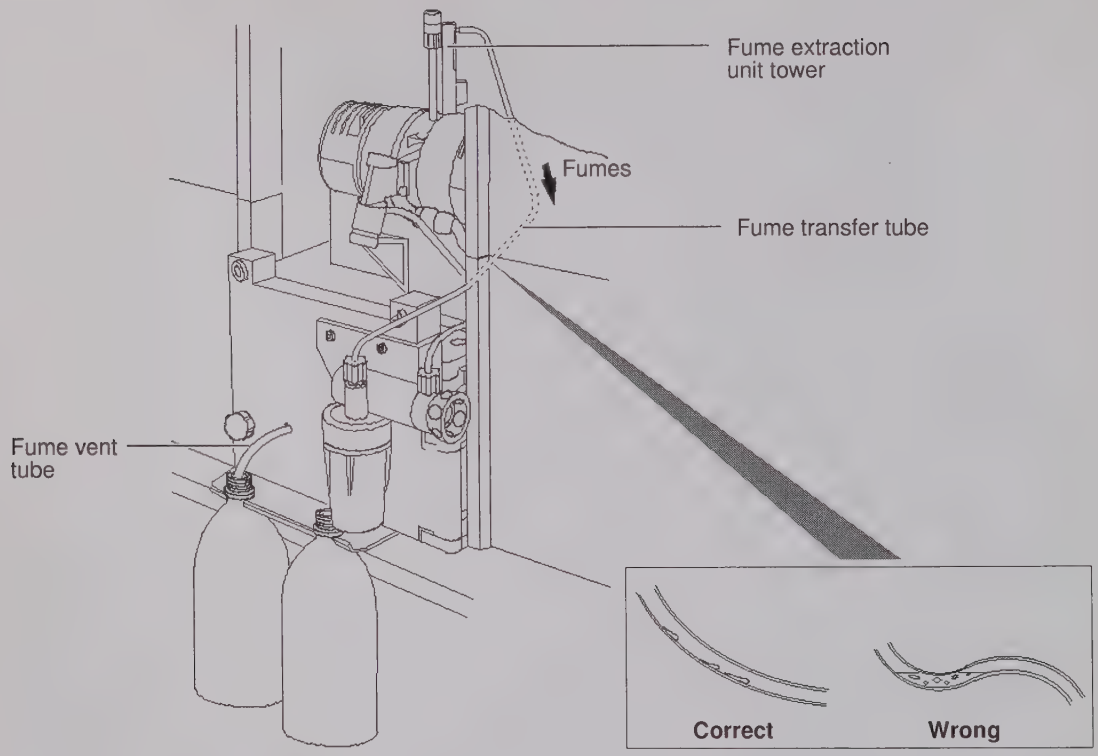
To clean the tube

1. Clean the tube with a dilute solution of laboratory detergent, dilute acid, ethanol, or deionized water.
2. Rinse the tube thoroughly with deionized water.
3. Inspect the tube carefully. If it shows signs of deterioration, discard it and fit a new tube.

To refit the tube

1. Push the knurled nut onto one end of the cleaned or new tube.
   Insert this end of the tube into the fitting on the separator trap and screw up the knurled nut firmly.
2. Pass the tube into the atomizer compartment and around the back of the graphite furnace to the tower of the fume extraction unit.
   Make certain that the tube does not obstruct the radiation beam.
3. Carefully push the tube onto the connector on the tower of the fume extraction unit.

Note: *Make sure that the tube descends continuously from the tower of the fume extraction unit to the separator trap without loops. This prevents liquid from collecting in any bends and thus restricting the gas flow. See the illustration on the following page.*



Note: *If obnoxious fumes are liberated from the furnace and they are not adequately trapped by the fume extraction unit, use a suitable length of tubing to connect the fume vent tube to a laboratory fume hood.*

Cooling System Maintenance

6

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Refilling the cooling system 6-6
Changing the cooling system fuse 6-7

Introduction

W1.2

Warning: Unauthorized Adjustments and Servicing

Only a Perkin-Elmer service engineer or similarly trained and authorized person should be permitted to service the instrument.

- *Do not attempt to make adjustments, replacements, repairs, or modifications to this instrument except as described in the documentation supplied with the instrument.*

If the cooling system will not function correctly...

- Switch off the spectrometer system and make sure it cannot be operated.
- Contact your local Perkin-Elmer office.
- Do not use the spectrometer without the cooling system, and do not attach any other cooling system to the spectrometer.

Caution: Risk of damage to the instrument from high water pressure

High water pressure may cause the coolant tubes on the furnace to burst. The cooling system includes a pressure-sensitive safety switch that switches off the pump if the pressure becomes too high for any reason. The pressure in the main laboratory water supply may be too high for safety.

- *Never connect the spectrometer system directly to the main laboratory water supply. Always use the cooling system.*

You should only perform the maintenance procedures described in this handbook. For any other maintenance or service contact your local Perkin-Elmer office to arrange for a service engineer to visit.
In particular you should only allow a Perkin-Elmer service engineer or similarly trained and authorized person to perform any work on:

- Electrical components inside the instrument;
- The gas connections and gas system pneumatics;

Before the service engineer arrives:

1. Make sure that the instrument and work area are clean.
2. Empty the furnace autosampler waste bottle.

Troubleshooting

See the *Troubleshooting* guide supplied with the system. This includes information about problems that can arise with both the software and the spectrometer system.

Routine maintenance checklist

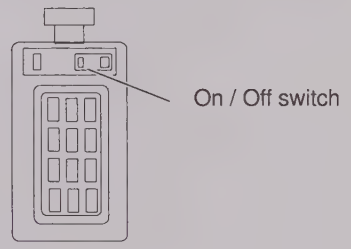
The cooling system is constructed from high quality components and requires very little maintenance.

Cooling system, maintenance checklist	
Water level	Make sure that the water level is always at the MAX. mark. Fill up the system when necessary (*procedure: page 6-6*). If you need to move or store the cooling system, you must empty the system (*procedure: page 6-5*).
External surfaces	Wipe over the surfaces with a lint-free cloth moistened with a dilute solution of laboratory detergent. The surfaces are resistant to dilute acids and alkalis, and to a lesser extent to strong acids and alkalis and organic solvents.

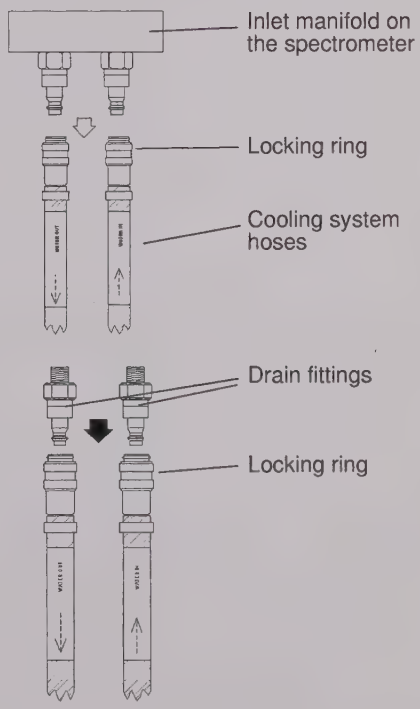
Emptying the cooling system

Usually there is no need to empty the cooling system. This may only be necessary when you want to move the complete analysis system to a new location.
The hoses attached to the cooling system have automatic valves that shut when you disconnect them from the inlet manifold of the spectrometer.
To empty the cooling system you require two drain fittings to open the valves.

1. Shut down the system — see the guide: *Setting Up and Performng for Analyses*.
2. Switch off the cooling system with the switch on the rear panel.



3. Disconnect the hoses from the inlet manifold of the spectrometer.
   - Carefully pull on the knurled locking ring slightly to release the lock on the connector, then pull the connector off the fitting on
4. Remove the stopper from the top of the cooling system – twist and pull.
5. Hold the hoses over a waste water container or drain, and insert drain fittings into the automatic connectors.
   Allow the water to drain out of the system.
6. Carefully pull the locking ring on the drain fitting down slightly to release the lock, then pull the drain fitting out of the connector.



Refilling the cooling system

The coolant is a 1:10 solution of glycerine in water (1 part glycerine plus 9 parts water). Do not use antifreeze. You must use the correct mixture when you refill an empty cooling system. To top off the system you can use clean, sediment free water — see below.

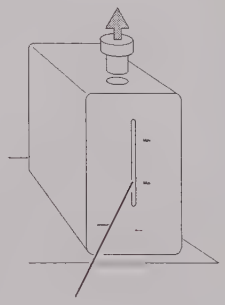
The cooling system is self-priming; air in the system is removed automatically as the cooling system operates.

To top up / top off the cooling system

1. Shut down the system — see the *Setting Up and Performng for Analyses* guide.
2. Remove the stopper from the top of the cooling system – twist and pull.
3. Fill the cooling system up to the **MAX** mark with deionized water or sediment free drinking water.

To refill an empty cooling system

1. Make sure that you remove the drain fittings from the cooling system hoses as described above.
2. Remove the stopper from the top of the cooling system – twist and pull.
3. Pour 0.5 L of glycerine into the cooling system.
   Do not use antifreeze.
4. Fill the cooling system up to the MAX mark with deionized water or sediment free drinking water – about 4.5 L.
5. Replace the stopper securely.
6. Attach the cooling system to the spectrometer as described in the *Installation* guide.



Water level indicator

Changing the cooling system fuse

In addition to the fuse in the cooling system, shown here, there is a fuse in the power outlet on the spectrometer.

W2.3

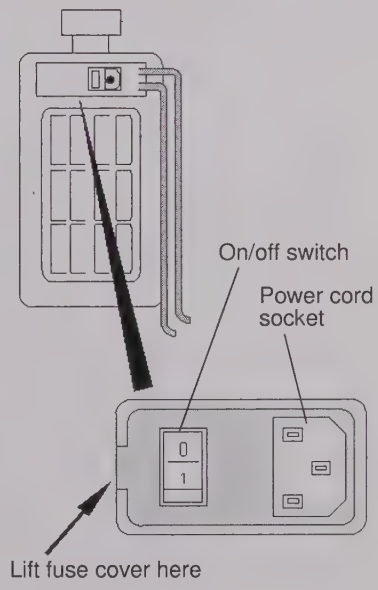
Warning: Electrical Hazard

- *To prevent potential injury to yourself and damage to the instrument, switch OFF all instruments in the system and disconnect them from the line power supply before you perform the procedures described below.*

W2.9

- *Use only fuses with the correct current rating and of the specified type for replacement.*
- *Do not use makeshift fuses and do not short-circuit the fuse holders.*

1. Shut down the system — see the *Setting Up and Performng for Analyses* guide.
2. Switch off the cooling system with the switch on the rear panel.
3. Disconnect the line power cord from the socket.
4. Behind this socket is the cover of the fuse holder.
   Use the tip of a small screwdriver to carefully lever open the fuse holder.
5. Remove the blown fuse.
6. Insert a new fuse of the correct type and rating.
   Correct fuse: 230 V, 1.6 A, slow-blow.
7. Close the fuse holder and reconnect the line power cord.
8. Switch on the cooling system with the switch on the rear panel.



Parts and Supplies

7

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Obtaining supplies, accessories, and replacement parts

Supplies, accessories, and replacement parts can be ordered directly from Perkin-Elmer, using the part numbers quoted in this guide.
Perkin-Elmer's catalog service offers a full selection of high-quality atomic spectroscopy supplies through the *Atomic Spectroscopy Supplies Catalog*.

To place an order for supplies and many replacement parts, request a free catalog, or ask for information:

- If you are located *within the U.S.*, call toll free **1-800-762-4002**, 8 a.m. to 8 p.m. EST. Your order will be shipped promptly, usually within 24 hours.
- If you are located *outside of the U.S.*, call your local Perkin-Elmer sales or service office.

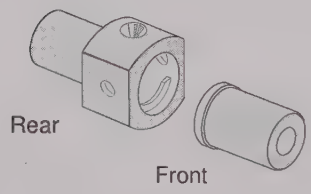
What is listed in this chapter

This chapter lists the most important replacement parts for your graphite furnace system. Information about consumables, and other parts and accessories is given in the current Perkin-Elmer supplies catalog.

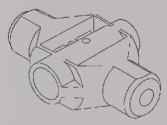
Furnace components

Description	Part No.
Graphite tubes, pack of 20	B050-4033
pack of 5	B300-0641
Graphite tubes, with end caps, pack of 20	B300-0655
pack of 5	B300-0653
Graphite contacts, 5 sets	B050-4036
O-ring, for the front contact housing and the optical sensor in the rear contact housing	B013-2870
Set of tools, for the contacts and the furnace windows	B312-0405
Key for furnace windows, separate	B050-5339
Grips for graphite tube	0990-7925
Dental-type mirror for checking the drying step	B085-1900
Furnace window, quartz	B019-8005
Furnace window seal	B050-1236

Graphite contacts



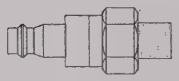
Graphite tube



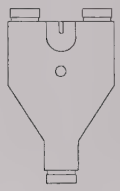
Furnace window parts

Furnace gas and cooling systems

Description	Part No.
Drain fitting for the automatic connectors, to empty the cooling system hoses	B019-3243
Gas tube	B050-8264
Tube cutter for the gas tube	0992-3183
Y-connector for the gas tube	0992-0179



Drain fitting



Y-connector

Fume extraction unit

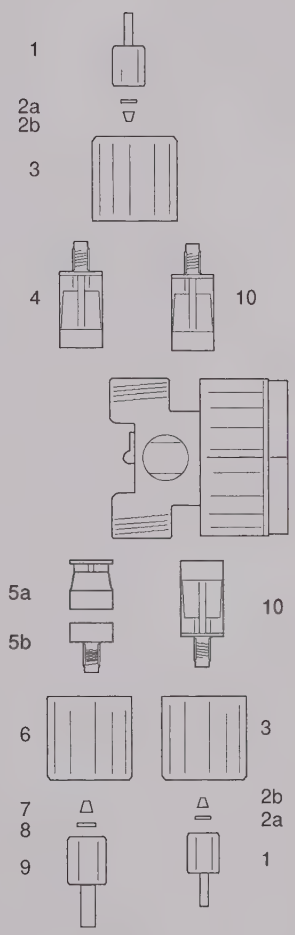
Item	Part No.
Filter cartridges, pack of 50	B050-9065
Fume transfer tube, FEP	B050-3002
Nozzle, graphite	B050-6722
Rinsing funnel for cleaning the extraction pump	B050-8836
O-ring, nozzle plug	B050-3007
O-ring, nozzle holder	B050-7230
O-ring, separator trap	B050-9057
O-ring, filter holder and rinsing funnel	B050-9058

Furnace autosampler

Description	Part No.
Rinse pump valve kit (contains both valves)	B300-1485
Inlet valve assembly	B300-2007
Outlet valve assembly	B300-2006
Tube cutter, for PTFE tubing	B051-0268
Solvent resistant rinse and waste bottles, 1 L, PTFE, x2	B300-1455
Pipet assembly	B012-9258
Connecting tube, PTFE, to connect the rinse and sample pumps	B002-9792

Pump parts

1	Nut, for 1/16" tube	B300-2089
2	Ferrule kit, 1/16" contains 5 front ferrules (2a) and 5 back ferrules 2b)	B008-6142
3	Valve retaining ring for rinse pump outlet and sample pump inlet and outlet	B009-2450
4	Outlet valve (rinse pump) complete with ferrules (2a, 2b) and nut (1)	B300-2006
5	Inlet valve (rinse pump) complete with valve (5a), tube connector (5b), ferrules (7, 8) and nut (9)	B300-2007
6	Valve retaining ring for the rinse pump inlet	B300-1327
7	Front ferrule, 2.45 mm	B300-1333
8	Back ferrule, 2.45 mm	B300-1334
9	Nut, for 2.45 mm tube	B314-0226
10	Tube connector for the sample pump	B300-2010



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Supplies, replacement parts, and accessories

Supplies, replacement parts, and accessories can be ordered directly from Perkin-Elmer, using the part numbers quoted in the handbooks provided with the instrument.

Perkin-Elmer's catalog service offers a full selection of high-quality supplies.

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